The Engineer.

VOL. CLV.—FROM JANUARY TO JUNE, 1933.

London:

OFFICE FOR PUBLICATION AND ADVERTISEMENTS, 28, ESSEX STREET, STRAND, W.C. 2.

JANUARY 6, 1933.—VOL. CLV.

THE ENGINEER.

A Seven-Day Journal

New Year Honours.

IN the list of New Year Honours conferred by the King, the following names are to be found:—Sir Walter Runciman, Bart., senior partner of the firm of Walter Runciman and Co., Ltd., chairman and managing director of the Moor Line of cargo steamships, and the Doyen of British shipping, is created Baron. The chairman of the Shipping Federation, Frederick Charles Allen, is created Baronet. Mr. Allen is an ex-President of the Chamber of Shipping and deputy-chairman and a managing director of the P. and O. Line. Knighthoods are conferred upon E. G. Stenson Cooke, the secretary since 1905 of the Automobile Association; Harley Hugh Dalrymple Hay, for his inventions and services in connection with the construction of tube railways, while Engineer Rear-Admiral George Preece and Major-General George Henry Addison, Engineer-in-Chief, Army Headquarters, India, become C.B. in the Military Division. For Dominions service the order of C.M.G. is conferred upon John Job Crew Bradfield, D.Sc., M. Inst. C.E., Government Engineer to the Sydney Harbour Bridge, and James Marchbanks, M. Inst. C.E., Manager and Chief Engineer of the Wellington Harbour Board, New Zealand; and for Colonial service on Colonel Charles John Chappell Ward, Port Director and General Director of Navigation at Basra, Irak. Sir Gilbert Christopher Vyle, Kt., Past-President of the Association of British Chambers of Commerce, and one of the industrial advisers of the United Kingdom delegation at Ottawa, becomes K.B.E.; Mr. Julian Piggot, of the British Steel Export Association, becomes C.B.E.; and Sydney William Smith, D.Sc., Chief Assayer at the Royal Mint, and President of the Institute of Mining and Metallurgy, is made C.B.E. in the Civil Division.

Watt Memorial Institute.

IN order to commemorate the life and work of James Watt, a memorial institute is to be opened in York House, Great Charles-street, Birmingham, which will provide a meeting hall and library for the various engineering societies. It was originally intended to purchase a site and build a suitable institute, but for financial and other reasons this meant postponing the scheme for an indefinite time, so it has now been decided to acquire premises providing a suitable meeting hall, a library, cloakrooms, and other necessary accommodation. The working costs are to be provided from the interest on the several thousands of pounds held by the trustees of the Watt Memorial Fund for the purpose of building the Memorial Institute, and by contributions already promised from engineering societies and from individuals. The trustees hope that the effort they are making to commemorate the work of James Watt, and to provide now a home for the various engineering societies, will meet with the approval and support of those who originally subscribed to the fund in 1919.

Two Manchester Engineers.

BY the death of Mr. Joseph H. Stubbs, which occurred unexpectedly at his home in Victoria Park on New Year's day, Manchester has lost one who played a prominent part in the engineering activities of Lancashire for more than twenty-five years. He was for many years chairman of the firm of textile machinists which bore his name, and was also chairman until a few years ago of Electromotors Ltd. Mr. Stubbs devoted much of his time to furthering the objects of local technical and trade societies. He was for some time chairman of the Engineering Employers' Federation, President of the Manchester Association of Engineers, and President of the Engineers' Club, of which he was a founder, life member, and active supporter until his death. Mr. Stubbs was a member of the Institution of Mechanical Engineers. The death of Mr. William H. Vaughan, which occurred recently at his home in West Didsbury, Manchester, at the age of seventy-seven, marks the passing of one of the pioneers of the electric crane industry in this country. After completing his education at the Lincoln Grammar School in 1871, Mr. Vaughan entered on an apprenticeship at the works of Ruston, Proctor and Co.—now Ruston and Hornsby, Ltd.—where his father was works manager. Later, he joined the firm of Vaughan and Stubbs, founded by his father, and, on the retirement of Mr. Stubbs, he undertook the management of the business, the title of which was altered to Vaughan and Son. In 1885, the building of overhead rope-driven travelling cranes was begun at the works at West Gorton. Shortly afterwards the firm took up the manufacture of multi-motor overhead electric travelling cranes and claims to have been the builder of the first crane of this type produced in the British Isles. Later, in 1898, the firm was converted into a limited company with the title of Vaughan and Son, Ltd., subsequently becoming the Vaughan Crane Company, Ltd. Mr. Vaughan was a valued Manchester member of the Institution of Mechanical Engineers.

The Galloway Power Scheme.

AN interesting stage in the tunnelling operations at Glenlee, near Dalry, in connection with the Galloway hydro-electric scheme, was reached last week, when the first junction, linking up the drives from the portal and the adit, a distance of almost 3600ft., was successfully effected by a shot electrically fired from the adit mouth. The tunnel, which will be 11ft. 6in. in diameter, is to be driven through 20,000ft. of hillside, and will convey water collected in the 1000-acre dam to be built at Clatteringshaws to the Glenlee power station, one of the five stations which are to be constructed along the valley of the Dee and the Ken. The shot, which was fired by Captain Wickham Weeks, Convener of the Stewartry, was quite successful, and inspection showed that a perfect join up had been effected. Among those present at the ceremony were Mr. W. Hudson, resident engineer to the Galloway Water Power Company; Mr. A. M. Carmichael, of Edinburgh, the contractor in charge of the work; Mr. A. McDonald, agent; and various engineers and county officials. Good progress is being made with this part of the scheme, and the work is almost six weeks ahead of schedule. The driving operations were begun in September and about 8000ft. have now been completed, 3600ft. between the portal and the adit and the remainder between the adit and a shaft further along the line and at the intake.

Queen Victoria's Railway Saloon.

THE saloon coach in which Queen Victoria made many of her journeys by train is to be preserved by the L.M.S. Railway Company at its works at Derby, whither it has been removed from Wolverton, owing to the space at the latter works being required for other purposes. This historic vehicle, which was always used by Queen Victoria when she travelled by rail, and in which she made numerous journeys between Windsor, Gosport and Ballater, was originally constructed in 1869 at the former London and North-Western Railway's works at Wolverton in the form of two separate saloons each 30ft. long and gangwayed together, but in 1895 the bodies of these two saloons were joined together to form the present coach. The saloon in its present form is 60ft. long and 8ft. wide, and contains two compartments for day and night use. It is mounted on two six-wheeled bogies, which gave great comfort in riding. A feature of the equipment of the saloon is that both oil lamps and electric light are provided in accordance with the wish expressed by Queen Victoria.

A Shipping Jubilee.

ON January 1st the Shaw, Savill and Albion Company, Ltd., commemorated the fiftieth anniversary of the amalgamation of the Shaw, Savill Company with the Albion Line. The joint company was registered in November, 1882, with a capital of £700,000, and began its activities in January, 1883. In an historical statement the management recalls the early beginnings of the company in New Zealand shipping under the leadership of Mr. Walter Savill and Mr. R. E. Shaw, and traces the steps from ship-breaking and ship chartering to shipbuilding, in conjunction with the Albion Line, which was then owned by Mr. Patrick Henderson, of Glasgow, who maintained services to China and to Burma, as well as to New Zealand. A notable addition was made to the Shaw, Savill and Albion fleet on Saturday last, December 31st, when Southampton officials welcomed the "Akaroa," a 15,000-ton oil-burning steamer which is the largest in the New Zealand trade. Last year she was the Aberdeen and Commonwealth Liner "Euripides," but since being acquired by her new owners has undergone an extensive reconstruction at the yard of R. and W. Hawthorn, Leslie and Co., Ltd., which has involved an outlay of £100,000. Her boilers have been converted from coal to oil burning, and her refrigerated capacity has been more than doubled, while considerable improvements have been made in her public rooms and passenger accommodation, making her practically a new ship with all modern facilities and improvements.

The Chief Engineer of the Mauretania.

AT the end of last year Mr. Andrew Cockburn, R.D., R.N.R., retired from the Cunard Line, after forty years of service, the last thirteen of which were spent as chief engineer of the "Mauretania." It may be recalled that although this famous liner began breaking Atlantic records in 1907, her fastest westbound and eastbound voyages were made in August, 1929, when Mr. Cockburn was in charge of her machinery. It is no secret that on those notable occasions she was run at absolutely full power, and although her machinery was designed for 70,000 S.H.P., more than 79,000 S.H.P. was developed. Mr. Cockburn has had a wide and interesting experience. He was born at Kelso in 1871, and served his apprenticeship with Morrison and Co., of Leith, attending, in the evenings, classes arranged by Locker's Engineering Academy. He worked with Hawthorn, Leslie and Co., at Newcastle, and later joined the shore staff of the Cunard Company. His first appointment was that of second engineer to the "Lucania" on her maiden voyage, and at one time and another he served in no less than five record-breaking ships of the Cunard Line. His war experience included service in the "Aquitania," and he was senior second engineer in the "Lusitania" when she was torpedoed in May, 1915. When serving as chief engineer of the "Aurania" in February, 1918, this ship was torpedoed. He held the rank of Lieut.-Commander R.N.R., and was awarded the Royal Decoration before the war. He is a Vice-president for the Merchant Navy of the Institute of Marine Engineers.

Fire on the French Liner L'Atlantique.

ON Wednesday morning, January 4th, a serious fire broke out on the French luxury liner "L'Atlantique" between Cherbourg and Le Havre, as she was proceeding from Pauillac Bordeaux to Le Havre for overhaul and repairs. Fortunately, there were no passengers aboard, and the crew, numbering about 260, was transported to other ships, which were brought alongside by the wireless signals for aid. The ships taking part in the rescue included the Hamburg Amerika liner "Rhur," and the Newcastle steamer, the "Ford Castle." The "L'Atlantique" is a 730ft. vessel, of over 42,000 gross tons. She was built at the Penhöet Yard, St. Nazaire, for the Bordeaux-South America service of the Compagnie de Navigation Sud Atlantique, and commissioned early last year. She is propelled by quadruple-screw Parsons geared turbines, of about 45,000 S.H.P., and was illustrated and briefly described in our issue of January 1st, 1932. One of her principal features is a 450ft. "street of shops" in the passenger accommodation, called the Rue Centrale, in which are to be found branches of the principal Paris stores. She contains British auxiliaries and machinery, and material delivered by Germany on account of reparations.

Aeronautics in 1932.

RELATIVELY to most other branches of engineering and allied activity, the British aircraft and aero-engine industry was in general happily circumstanced during 1932. Thanks undoubtedly in large measure to the world-wide prestige and reputation for soundness and high performance resulting from success in the Schneider Trophy contests and other spectacular events, valuable orders for British machines and motors continued during the year to be received from overseas countries. This fact, and the negligible amount of foreign competition in the home market, sufficed to provide a good level of activity in nearly every aircraft and aero-engine establishment in Great Britain.

There were, however, two main features of the situation which introduced a disturbing element into the outlook of the industry. In the first place, the Air Ministry, to which our aeronautical establishments still look for a large proportion of their orders, was compelled, like other Government Departments, to effect a very rigid economy in its expenditure. As a consequence, it had to reduce the measure of encouragement which it has long given to manufacturers to produce new designs of machines. The result is to be seen in the record which we present below. It will be observed that a large proportion of the time and activity of a number of aircraft manufacturing firms was devoted to the modification and improvement of existing types rather than to the much more expensive process of producing entirely new designs.

Secondly, the situation has been disturbed by a political issue, the general question of disarmament among the nations and, in particular, the prohibition of heavy bombing machines with which the international control of civil aviation is inevitably associated. These subjects are still in the region of debate, but until they are settled one way or the other they are bound to affect the outlook for the aeronautical industry.

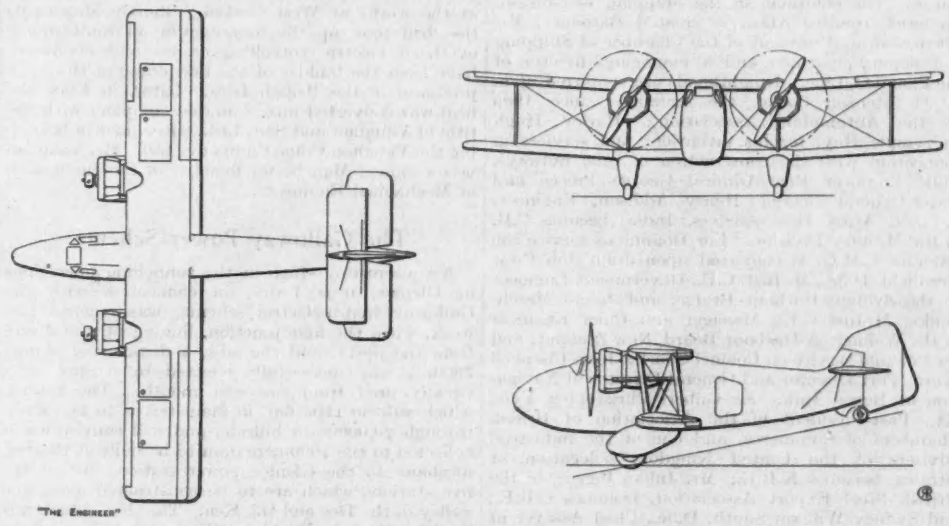
This second factor, being largely political, is somewhat outside our present province, although we recognise that, granted the desirability of some measure of aerial disarmament, its practicability involves technical as well as political considerations. Concerning the first factor, granted the necessity for Government economy, the considerations to be taken into account are almost wholly technical. We might be inclined to regret the partial halt which has been called in the production of new types of aircraft, for in the past the enterprise of our manufacturers in that direction has been a considerable element in maintaining the leading position acquired by their products among the nations. Nevertheless, it may not be wholly to their disadvantage that circumstances have compelled our aircraft builders to turn for a time more to the improvement of existing types than to the creation of entirely new designs. It is undoubtedly true that waste of effort and money has been incurred in the past by the abandonment of promising designs before all the possibilities of improvement suggested by practical experience of the machines in the air have been fully tried. The work done by several firms during the past year has shown that within the limits of existing designs, it is possible by effecting modifications to secure an enhanced speed or performance of the same order as that which might be expected from a completely new design. It seems scarcely credible that at this late date it should be possible to add 20 or more miles an hour to the speed of a machine by going carefully over all the details of its design and modifying them, where possible, to give reduced resistance. Yet that feat has been accomplished within recent months, not in one machine, but in several of widely different types. The wonder is not that it should have been done, but that the original design should have been such as to permit the improvement.

We must not, however, assign all the credit for the improvements effected to the defects of the original design. Share in the credit is to be given to the adoption of such additions as the Townend ring to reduce the drag of the engine, and of wind shields for the undercarriage wheels. Above all, developments in the design of aero-engines have helped to make improvements possible in the performance of existing types of machine. In this connection, as the reader of the succeeding notes will discover for himself, more than passing praise is due to the Bristol Aeroplane Company for the boldness with which it set about the redesigning of the famous "Jupiter" engine, and for the success of its efforts to produce something still better, as represented by the new series of "Pegasus" engines. Other engine builders, notably the Armstrong Siddeley and the Rolls-Royce companies, have also been active recently in improving the characteristics of their products, and it is not too much to say that without these improvements in the power units available to them, aircraft manufacturers would have been prevented from realising the larger part of the gains which have accrued from the redesigning of their existing types.

THE AERONAUTICAL INDUSTRY.

We give below some notes on the principal work, so far as it is permissible to describe it, carried out during the year by British aircraft and aero-engine builders.

Boulton and Paul, Ltd.—The most important aeronautical work carried out at Norwich by Boulton and Paul, Ltd., consisted of the design and construction of the twin-engined high-speed mail carrier illustrated herewith. This machine was produced to an Air Ministry specification calling for a machine capable of carrying 1000 lb. of mail non-stop for 1000 miles at 150 m.p.h. This performance is to be given in regular routine service, and is therefore not the maximum performance of which the machine would be capable if relieved of all accessories and conveniences. In addition to the mail, the machine is required to carry a pilot and a navigator, and has to be capable of being loaded, unloaded and started without the aid of large handling parties. The machine produced by Boulton and Paul to meet this specification is a twin-engined tractor biplane, designed to give the specified normal speed of 150 m.p.h. with each engine developing about half its maximum output. If one engine breaks down in flight it is anticipated that the machine will still be able to maintain level flight at 5000ft. without taxing the remaining engine to its full rated power. The pilot's cockpit is totally enclosed and is fitted with two side-by-side seats and dual control. Behind the cockpit is a navigating and wireless room to which either of the occupants of the cockpit seats may, without inconvenience to the other, retire for food or rest. A door at the end of the navigating room permits the crew to reach the mail compartment when the machine is in flight, but a separate side door is provided for the loading and unloading of the mails. The mail is stored in standard bags stowed along each side of the compartment so as to leave a gangway down the centre by which any one bag may be reached without disturbing the others. The machine is constructed of high tensile steel in the heavily stressed parts, and of light alloys elsewhere. In general design the most notable departure from standard practice consists of the mounting of the engines on the upper wings. With this arrangement the necessary clearance of the air-screws from the ground is secured with an undercarriage of low height and resistance. The use of retractable wheels would have still farther reduced the undercarriage resistance, but model tests showed that the gain over the arrangement adopted would have represented only 2 to 3 miles per hour in top speed, and that at the specified cruising speed and range the extra petrol required to overcome the resistance of the fixed undercarriage actually adopted would be less in weight than the extra weight involved in fitting a retractable undercarriage. The machine is now in an advanced state of construction, but has not, as yet, been tested. It will have a span of 54ft. and a fully laden weight of 10,500 lb. With two Bristol "Pegasus" engines of 555 B.H.P. each, it is expected to have a maximum speed of 195 m.p.h. at 5000ft., and a cruising speed of 172 m.p.h. at two-thirds maximum power.



BOULTON AND PAUL TWIN-ENGINED MAIL CARRIER

Spartan Aircraft, Ltd.—At the Cowes works of Spartan Aircraft, Ltd., attention was concentrated on two types of machine—the Mark II. three-seater light aeroplane and the Spartan "cruiser." The "cruiser," illustrated on page 16, is a development of the Spartan mailplane, which we dealt with a year ago. It is a six-seater, three-engined monoplane. The engines are Gipsy III. de Havillands, two of them being mounted on the cantilever wings and the third at the nose of the fuselage. The fuselage is of metal construction throughout, the covering consisting of "alclad." The wings, on the other hand, are of wooden construction throughout with a covering of three-ply. The tail unit consists of a duralumin framework with fabric covering. Two fuel tanks, each with a capacity of 60 gallons, are housed in the wings and from them each engine draws its supply by means of its own fuel pump. Palmer hydraulic brakes are fitted to the landing wheels, and can be operated together or separately. The cabin contains seats for five passengers and the pilot, and is provided with "Triplex" side windows and celluloid windows in the roof. Behind the cabin is a large space for the stowage of luggage. It is claimed that the machine can maintain flight under full load with one of its engines out of action. Its fully loaded weight is 5500 lb., which may be made up of the pilot and five passengers, plus 90 lb. of luggage, or, with the cabin furnishings removed, of the pilot and 1010 lb. of freight. The cruising speed in the fully laden condition is 110 m.p.h.

The Cierva Autogiro Company.—An interesting and important development was made in the "Autogiro" during the year. As shown in a Supplement, the new design, designated the "direct control" type, dispenses entirely with the fixed wings, elevators and ailerons, which characterised all the earlier forms of "Autogiro." The only horizontal surface now remaining is the small tail plane, but it is employed only for stabilising purposes, and is not used in any way for the control of the machine, the whole of which is derived from the rotor itself. The cockpit is fitted with the usual "joy stick" and rudder bar. The latter operates the rudder in the ordinary manner, but the "joy stick" moves the rotor blades either about a longitudinal or a transverse axis and thereby gives a control equivalent to that derived in an aeroplane from the movement of the ailerons or elevators. As in the earlier forms of "Autogiro," the rotor is not directly driven by the engine, its motion being derived when the machine is in flight from the forward movement through the air induced by the pull of the tractor screws. Three forms of direct control "Autogiro" are being built. One will be a single-seater, with a 40/50 H.P. engine. Another will be a side-by-side cabin machine, and the third will be a four or five-seater for freight or passenger transport.

Short Brothers, Ltd.—The completion and successful trials of the large six-engined boat-seaplane illustrated in a Supplement constituted the chief item of interest in the year's work at Messrs. Short's Rochester establishment. This machine was built to the order of the Air Ministry. It is driven by six Rolls-Royce "Buzzard" geared engines developing normally 820 B.H.P. at sea level. It has a maximum all-up weight of 70,000 lb., and is constructed chiefly of duralumin and stainless steel. It has a span of 120ft., an overall length of 89ft. 6in., and a height of 30ft. 4in. This machine is less an experiment than a logical development of the policy of progressive flying boat design which the company began about 1921. It will, itself, it is anticipated, provide a step in the progress towards the construction of flying boats for cross-Atlantic services.

To what extent progress is still possible by effecting improvements of detail is illustrated by some work carried out by the firm during the year on its "Singapore" Mark II. flying boats. As an outcome of research in the company's experimental tank a new type of planing bottom was evolved for this class of machine with the result that it is now capable of taking off from the water with a load 35 per cent. above the designed all-up weight. Development work was also carried out on stainless steel floats. A satisfactory design employing a very simple construction was evolved. The design is such that any repairs required can be carried out without elaborate equipment. If the tests of the new float prove successful, it is possible that all floats for service seaplanes may be changed over to stainless steel

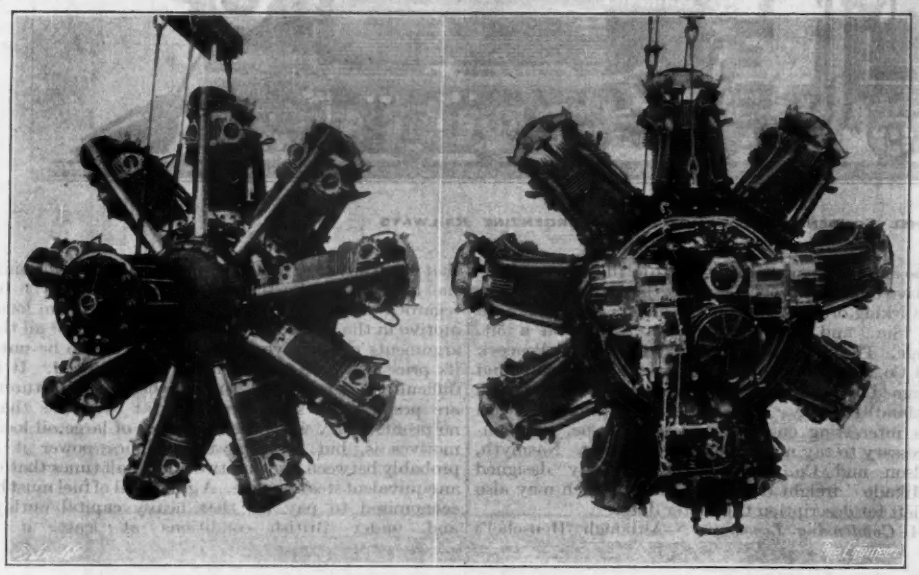
construction. New wing structures were also tested during the year, and in a twin-engined general purpose boat-seaplane now under construction the new form of wings is being adopted. Short "Calcutta" machines continued to be produced in France by Messrs. Breguet, while in Japan the first of a Short design of three-engined boat seaplane was built for naval use.

The Bristol Aeroplane Company, Ltd.—The 1933 type of Bristol "Bulldog" single-seater day and night fighter—see page 16—is a development of the Mark II. A design, which we illustrated five years ago, and with which ten out of the thirteen single-seater squadrons of the Royal Air Force are at present equipped. The new type has a speed of well over 200 m.p.h. Like its forerunner, it is built of high tensile steel, but in a number of details it is different. The engine has been changed from a Bristol "Jupiter" to a Bristol "Mercury," thereby gaining not only an increase of power, but a reduction of diameter. A geared-down drive to the airscrew and the fitting of a Townend ring round the engine have added to the efficiency of the power unit. A change in the wing section to that known as R.A.F. 34 has enabled the designers to make the fuel tanks in the wings conform with the wing section and to bring the weight of the fuel nearly 2ft. nearer the centre line of the machine. The effect of these two changes has been to improve the efficiency of the wing and to reduce the lateral moment of inertia and thereby to increase the manœuvrability of the machine. Single lift wires of increased section have replaced the double wires of the earlier design, with a consequent reduction of resistance and of the tendency of the wires to vibrate. An improved type of joint between the wing spars and the interplane struts has been introduced and has enabled the fittings for the interplane struts and external bracing wires to be almost completely contained within the wing profile, thereby materially reducing the resistance. A reduction of 7in. in the chord of the lower wing has increased the field of vision in an important direction. Other alterations include the strengthening of the fuselage by the employment of heavier gauge material, the lengthening of the undercarriage axle to give a wheel track of 6ft. 5in., and the fitting of foot-operated Bendix brakes to the wheels. The ailerons have had their stiffness increased to reduce their liability to deformation in flight and are statically balanced. The balanced portion of the elevator has been augmented in area and, as a consequence, the elevator control is both lighter and smoother in action than in the earlier design.

The company continued throughout the year its experimental work on the metal construction of aircraft, the subjects of chief interest investigated under this heading being the design of metal wings and of metal-covered fuselages.

On the engine side the company placed in production two new designs of air-cooled radial engine—the "Pegasus," of 500 to 600 H.P., and the "Mercury," a high-speed supercharged engine, developing from 500 to 560 H.P. Of the "Pegasus" type, ten different modifications are available, covering a wide range of airscrew speeds and performance at altitude. For the most part the new engines are similar to the Bristol "Jupiter" with the details redesigned. For use in conjunction with the new engines the company is now producing two, three and four-bladed airscrews with blades of light alloy.

The Blackburn Aeroplane and Motor Company, Ltd.—While production work was not plentiful at the Brough Works of the Blackburn Company, the establishment was busily employed throughout the year on the construction of no fewer than eight experimental or modified types of aircraft. The "Iris" coastal patrol flying boat was produced in a modified form with three Rolls-Royce "Buzzard" engines of 825 H.P. each substituted for three "Condors" of 650 H.P. each. Two new versions of the "Ripon" torpedo bomber were completed, the principal modification being the replacement of the Napier "Lion" water-cooled engine by a radial air-cooled engine, a Bristol "Pegasus" in one case, and an Armstrong-Siddeley "Tiger" in the other. Among the completely new designs produced during the year was a light aeroplane known as the B 2, which was developed primarily for military training purposes, but is claimed to be equally suitable for civil training or touring. Two very interesting civil machines were built for the Air Ministry. Both were designed to carry ten passengers, and each was driven by two Armstrong Siddeley "Jaguar" engines of 400 H.P. each. The fuselage, undercarriage and general equipment of the two machines were similar; in fact, the two were identical except that one was a monoplane and the other—illustrated in the Supplement—a biplane. The machines are to be used to determine the relative merits of the two types for civil purposes. The monoplane has a span of 86ft. and the biplane a span of 64ft., the wing area of the monoplane exceeding that of the biplane by 31 square feet. The official tests of the two machines have not been completed as yet, but it is understood that the builders' trials indicated a slight advantage as regarded top speed, landing speed, initial rate of climb and service ceiling in favour of the monoplane, in spite of the fact that its structural weight exceeds that of the biplane by over 400 lb. While it was expected that the monoplane would show to advantage in these respects, it was anticipated that the difference in the performances would have been greater than it turned out to be.



BRISTOL "PEGASUS" RADIAL AIR-COOLED ENGINE

Westland Aircraft Works.—At the Westland Works, Yeovil, the output of military aircraft and experimental work on new types provided a good measure of employment. During the early part of the year some "Wapiti" machines were completed for the Air Ministry. More than 500 machines of this design have now been supplied to various air forces. The firm has now developed a more advanced type of general purpose machine, known as the "Wallace," and illustrated on page 16. The wings of the "Wallace" are interchangeable with those of the "Wapiti," but, in a number of small but important respects, the fuselages are different. The design in general has been "cleaned up," and the consequent reduction of drag combined with the advantages derived from the "Pegasus" engine, which has been substituted for the "Jupiter" used in the "Wapiti" type, has resulted in a considerably enhanced performance. The manœuvring of the machine on the ground has been improved by fitting brakes to the wheels and by using a tail wheel in place of a tail skid. Attention has also been paid to improving the accessibility of the fuselage interior. At the forward end the metal covering is in the form of detachable panels, while, at the rear end, the fabric covering is provided with "Zipp" fasteners. The machine has a very high military load capacity. It may be flown with an all-up weight of 6500 lb., which is sufficient to enable it to carry extra tanks for a non-stop flight of 1000 miles. With the normal tankage it may be adapted for training, fighting, bombing, or Army co-operation purposes, or for use as a seaplane. Its speed, it is stated, is surpassed only by that of the most recent specialised fighters and day bombers.

Work on the development of the Pterodactyl tailless machine was continued during the year. The latest model, known as the Mark IV., was exhibited in flight at Hendon in June, and was subsequently handed over to the Farnborough establishment for intensive experimental work.

The Fairey Aviation Company, Ltd.—The Hayes, Middlesex, factory of the Fairey Company continued to be engaged solely upon the design and construction of high-performance service aircraft. Large numbers of "Gordon" general purpose machines were supplied to the Royal Air Force and to a foreign Power. The "Gordon" is a development of the Fairey III. F, with an air-cooled "Panther" engine substituted for a water-cooled engine. Among the new machines produced at the factory was the heavy, long-range, night bomber, illustrated in our Supplement. It is understood to carry a crew of four and to be driven by two Rolls-Royce "Kestrel" engines. The long-range monoplane which we illustrated a year ago, has been delayed by bad weather, but it is expected to depart within a week or two on its attempt to surpass the non-stop long-distance flight record. The company received from the Belgian Government a repeat order for Fairey "Firefly" single-seater fighters, and Fairey "Fox" two-seater day bombers, both types being fitted with supercharged "Kestrel" engines of 500 H.P. The company's branch factory at Gosselies, in Belgium, continued to develop satisfactorily. The Fairey metal airscrew was produced during the year in a variable pitch form.

Vickers (Aviation), Ltd.—At the Weybridge works of Vickers (Aviation), Ltd., activities during the year were largely concentrated upon the development of existing types. The principal new design produced was the "Vellox," an advanced type of freight carrier or general-purpose machine, adaptable to a wide range of military or commercial duties. The well-known "Victoria" twin-engined troop carrier was produced in the form of a sixth edition, the chief alteration consisting of a change in the power plant to Bristol "Pegasus" air-cooled engines. This change has effected a reduction of about 224 lb. in the bare weight of the machine, and has given it a corresponding increase in load-carrying capacity, as well as a considerably improved performance. The company's twin-tractor biplane bomber was also fitted with "Pegasus" engines, as was the latest type of "Vildebeest" torpedo bomber, a view of which as a land plane is reproduced on page 16. The Vickers four-engined biplane night bomber, with four Rolls-Royce "Kestrel" engines arranged in tandem pairs, was converted to act as a troop carrier with capacity for twenty-four fully armed troops. The twin-engined "Vellore" biplane freight and mail carrier was adapted as a twin-float seaplane, and gave very satisfactory results on trial. A twin-engined all-metal "Viastra" high-wing monoplane passenger carrier, with two "Pegasus" engines, was ordered by H.R.H. the Prince of Wales, and work is now proceeding on adapting the design to His Royal Highness's requirements. On September 16th a Vickers "Vespa" biplane fitted with a Bristol "Pegasus" engine gained the world's altitude record, the pilot, Flight-Lieut. Uwins, taking the machine to a height of 43,976ft., or over 8¼ miles.

At the company's Supermarine Works at Southampton, work was carried out on the production of a "private venture" marine aircraft, which will be available in both service and civil form. No details of this machine will be published until it has been subjected to severe testing. The Supermarine "Southampton" type of flying boat was developed still further. In one form it was produced with Rolls-Royce "Kestrel" engines, and in the all-metal type of construction.

Saunders-Roe, Ltd.—The Saro "Cloud" and "Cutty Sark" designs of amphibian flying boat continued in production and development at the Cowes works of Saunders-Roe, Ltd. The "Cloud" machine was adopted during the year as the standard navigation and flying training machine for the marine side of the Royal Air Force. Two "Cutty Sark" machines were produced, each fitted with two 150 H.P. "Genet Major" engines. The increased power was found to facilitate taking off and rate of climb, factors of great importance where, as in the Far East, aerodromes are small and the surrounding country is mountainous. Another version of the "Cutty Sark" was produced. It had a single 215 H.P. "Lynx" engine. "Cutty Sark" or "Cloud" machines were employed during the year on commercial services between Glasgow and Belfast, between Liverpool and the Isle of Man, and between Australia and Tasmania.

The Gloster Aircraft Company, Ltd.—The Gloster Company continued to devote the chief part of its attention to the production of high-performance single-seater fighters. As a direct outcome of its experience in the construction of racing machines, it produced the S.S. 35, in which the usual type of honeycomb radiator associated with a liquid-cooled engine is replaced by surface condensers conforming to the profile of the wings. The S.S. 19, originally produced as a multi-gun fighter, was converted from that form into a day and night bomber, and is now attached to the Royal Air Force for observation purposes. In its new form this machine has an all-up weight of 3750 lb., and when fully equipped for service use and driven by a 480 H.P. "Jupiter" engine, its speed is 193 m.p.h. at 10,000ft., and 180 m.p.h. at 20,000ft. It can climb to the second-

named height in just over 16 min., and can attain an absolute ceiling of 27,100ft. While specialising in single-seater fighters, the company continued to develop the larger type represented by the twin-engined survey machine constructed three or four years ago. A second machine of this type, modified in certain details, was constructed for the Air Ministry for the purposes of electrical research work. Subsequently, the company received an order from the Ministry to build a large four-engined transport bombing machine, and it is now undergoing official trials. It has an all-up weight of 29,000 lb., and is driven by four Rolls-Royce "Kestrel" engines, developing a total of 1920 B.H.P. at normal speed and at 11,500ft. altitude. The cooling system employs steam condensers of the honeycomb pattern. The monocoque body is built up of smooth duralumin plates, and the wings have high-tensile steel spars. The Gloster-Hele-Shaw-Beacham variable pitch propeller continued to be developed, and one such propeller for the Rolls-Royce "Kestrel" engine was standardised, and is now under test at Farnborough.

Armstrong, Whitworth Aircraft, Ltd.—During the year the last of the fleet of eight "Atalanta" four-engined commercial monoplanes for the Imperial Airways African route was brought towards completion at the Coventry works of Sir W. G. Armstrong, Whitworth Aircraft, Ltd. Manufacture of the "Atlas" Mark II. general-purpose machine and of the A.W. XVI. single-seater fighter was continued, and a number of both types was sold abroad. In order to improve the control of the considerable number of Mark I. "Atlas" machines already in use in the Royal Air Force, ailerons were added to the lower wings and the work involved under this heading, together with a large amount of experimental and research work—including the design and production of stainless steel floats—kept the factory busy.

Armstrong Siddeley Motors, Ltd.—Generally speaking, Armstrong Siddeley Motors, Ltd., succeeded in extending all its markets for its aero-engines, and, in particular, from Brazil, China, Finland, and Norway encouraging business was received. The company added a new size of air-cooled engine to the range which it has been making for some time, namely, the 640 horse-power, 14-cylinder "Tiger." This engine lies between the 535 H.P. "Panther" and the 800 H.P. "Leopard," and is intended for use in general purpose and torpedo-carrying machines, flying boats, and civil aircraft. Among the new features embodied in the design of the "Tiger" engine are the enclosing of the valve rocker gear and push rods, and the fitting of cowls to direct the air round the backs of the cylinder barrels.

Rolls-Royce, Ltd.—Rolls-Royce "Kestrel" and "Buzzard" engines continued throughout the year to add to their reputation, and were extensively adopted at home and abroad on many different types of machine. The "Kestrel" engine was subjected to an official type test at an increased normal speed of 2500 r.p.m., and as a result its performance was improved by about 10 per cent. At this speed the engine can now develop 600 B.H.P. at sea level and 525 B.H.P. at 11,500ft. At 13,000ft. it can be run at 3000 r.p.m. to develop 575 B.H.P. At Farnborough the Royal Aircraft Establishment, in conjunction with Rolls-Royce, Ltd., succeeded in converting a "Condor" petrol engine into a compression ignition engine, and in putting it through the official fifty hours' type test. The converted engine has a weight of 1504 lb. and develops 480 B.H.P. at normal charge and 1900 r.p.m., or 500 B.H.P. at maximum charge and the same speed. It is now being tested in the air in a Hawker "Horsley" machine. The engine has twelve cylinders, and runs on the four-stroke cycle.

ONE of the conclusions arrived at by D. B. Gawthrop, of the Pittsburg Experiment Station, in the course of investigating electric detonators, as described in the *Journal* of the Franklin Institute, is that detonators containing a base charge of explosive, such as tetryl or picric acid, primed with an appreciable amount of a sensitive initiating explosive, such as mercury fulminate or lead azide, transfer detonation over the greatest distances.

Locomotive Building in 1932.

IF it were possible for any year to be worse in the locomotive-building industry than 1931, last year was it. The four Companies have nothing new to put on record. They developed no new steam types, built few engines themselves, ordered even less than usual from the manufacturers, and carried out no novel experiments. The solitary exception is the fitting of a booster to three tank engines of the L.N.E.R. used for pushing service in the Wath Concentration Yard. The engines date from 1907, and have three cylinders driving eight coupled wheels. There is a four-coupled bogie at the rear, the leading axle of which is driven by a reversible booster made by J. Stone and Co., Ltd., of Deptford. The first converted engine was illustrated in our issue of June 24th, in which the action and control of the booster was fully described with the help of a diagram.

When we turn from the four British Railway Companies to the locomotive-manufacturing firms, we find the record about as bad as it could be. Orders have been very few and far between, and, with the exception of a very large Beyer-Garratt engine for Russia, they were practically without exception for familiar or standardised types. The Beyer-Garratt, which we illustrate in a Supplement, is claimed to be the heaviest locomotive built in Europe; it turns the scales at 262 tons in working order. The four cylinders are all 22$\frac{7}{16}$in. by 28in., and drive 4ft. 11$\frac{1}{16}$in. wheels on a 5ft. gauge. The steam pressure is 220 lb. Beyer, Peacock and Co., Ltd., also built a three-cylinder compound designed by Mr. George Glover, for the Great Northern (Ireland) Railway. As we shall be dealing fully with this interesting engine in an early issue, it is unnecessary to say more about it at present. Nasmyth, Wilson and Co., Ltd., built a newly designed "Mikado" freight engine for China, which may also be left for description till a later date.

A Condensing Locomotive.—Although Henschel's first condensing locomotive was delivered to the Argentine Railways towards the end of 1931, its trials were only completed last year, and some account of it may appropriately be given here. The engine itself, see Fig. 1, is an almost normal 2–8–2, the principal difference being the replacement of the blast nozzle by a fan in the smoke-box. This change is necessary because the whole of the exhaust is led backwards to the front of the tender where it drives a turbine before entering an air condenser. The air for this condenser is provided by fans driven by the exhaust turbine. The sole object is to conserve the feed water and no effort is made to create a vacuum; in fact, the condenser is so proportioned that the indicator cards from the cylinders are practically the same as those from a normal engine. The exhaust is cleansed by passing through an oil separator, and the condensate flows into a de-aerator before being pumped back into the boiler. Any leakage or loss is made up from an evaporator, so that nothing but clean water is used. The condenser, which is shown in Fig. 2, is made up of six elements, three on each side, and resembles the design used in turbine locomotives. The engine was guaranteed to run 600 kiloms. without replenishment of feed water, but it has actually exceeded that guarantee by 50 per cent. The average consumption of water was about 8 litres per kilometre. We understand that a similar locomotive is to be supplied to the Soviet State Railways.

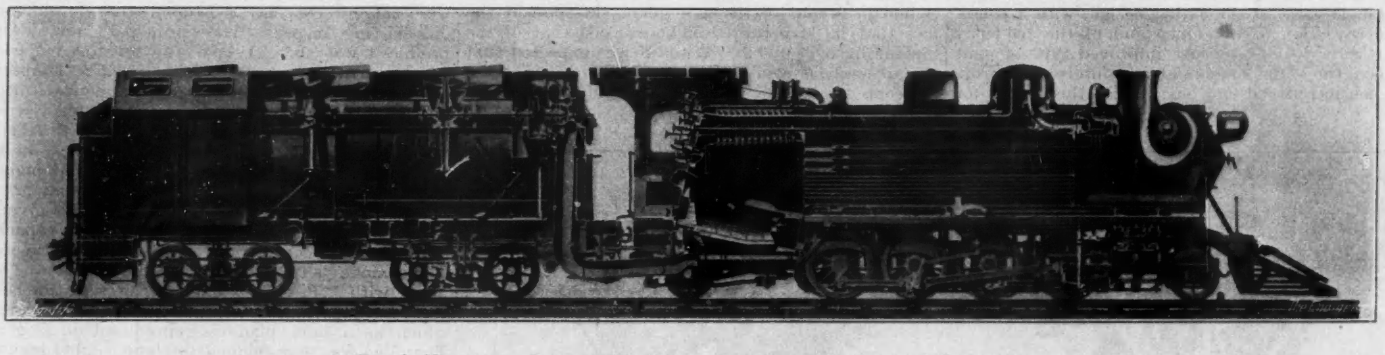


FIG. 1—HENSCHEL CONDENSING LOCOMOTIVE FOR ARGENTINE RAILWAYS

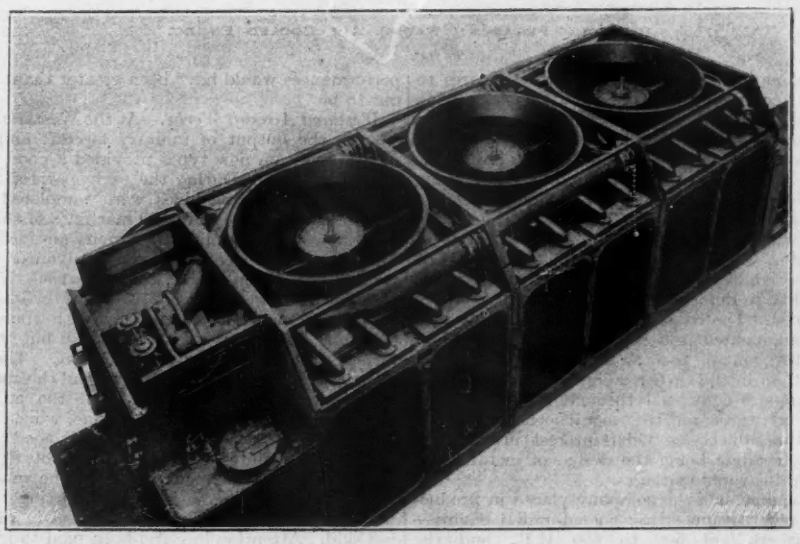


FIG. 2—CONDENSER FOR HENSCHEL LOCOMOTIVE

Oil Locomotives.

The chief interest in the locomotive year is to be found in the further progress of the oil engine for railway traction. Much has been written and more talked about the subject, and it must be admitted that some advance has been made. At the same time the internal combustion locomotive cannot yet be regarded as a serious rival of the normal steam locomotive in the United Kingdom, and in spite of all the arguments of its advocates it is unlikely to be until its price has been very considerably reduced. It is difficult, in these hard times, when manufacturers are prepared to sell their goods at even less than no profit, to say what the true price of large oil locomotives is, but horse-power for horse-power it is probably between two and two and a half times that of an equivalent steam engine. A great deal of fuel must be economised to pay for that heavy capital outlay, and under British conditions at least, it is not believed by the managements of railways that for general work the oil locomotive is an economical proposition. Where fuel costs are higher than in this country, or where good water is difficult to obtain, the case may be altered, and the efforts to produce an engine of much lower first cost than at present, and in which the high fuel economy is not diminished by high lubricating oil consumption deserve every encouragement. There is no doubt whatever that the internal combustion locomotive has an important future, and, owing to its cheapness of operation and independence of external power

supply, may justly be regarded as a serious rival of the electric locomotive.

The most notable oil locomotive of the year is unquestionably the one built by Armstrong, Whitworth and Co., Ltd., at Scotswood, for the Buenos Aires Great Southern Railway. It weighs 148 tons, and is virtually two identical units coupled tail to tail. Each unit carries an 850 B.H.P. oil engine driving a generator which supplies current to motors on three out of the four axles. The wheel base of each outer bogie is 8ft. 5in. and of the inner bogies 9ft., and the bogies are placed at 21ft. centres.

This locomotive is similar save in certain dimensions to three mobile power-houses built by Armstrong, Whitworth and Co., Ltd., and illustrated by a drawing, Fig. 3, and a picture in one of our Supplements. These mobile power-houses will be used for the propulsion of 8-coach electric trains on the Buenos Aires Great Southern Railway. Each unit carries an 850 B.H.P. Sulzer oil engine and Brown-Boveri generator which supplies current to two axle-suspended English Electric motors on each of the eight coaches. The auxiliary equipment of the power units comprises, an engine-starting battery of nickel-iron cells; water cooling apparatus for the engines; and two auxiliary generators (house sets) mounted on extensions of the engine shafts. These generators charge the batteries, drive the radiators, fans, &c.

The same firm also completed an oil-electric shunting engine, which is undergoing complete trials on the L.N.E.R.

A much smaller, but still interesting, oil locomotive was completed at the Derby works of the L.M.S.—see Supplement—specifically to ascertain what economies could be secured. It is one of the company's 0-6-0 shunting engines converted by the removal of the engine and boiler and the replacement of the front

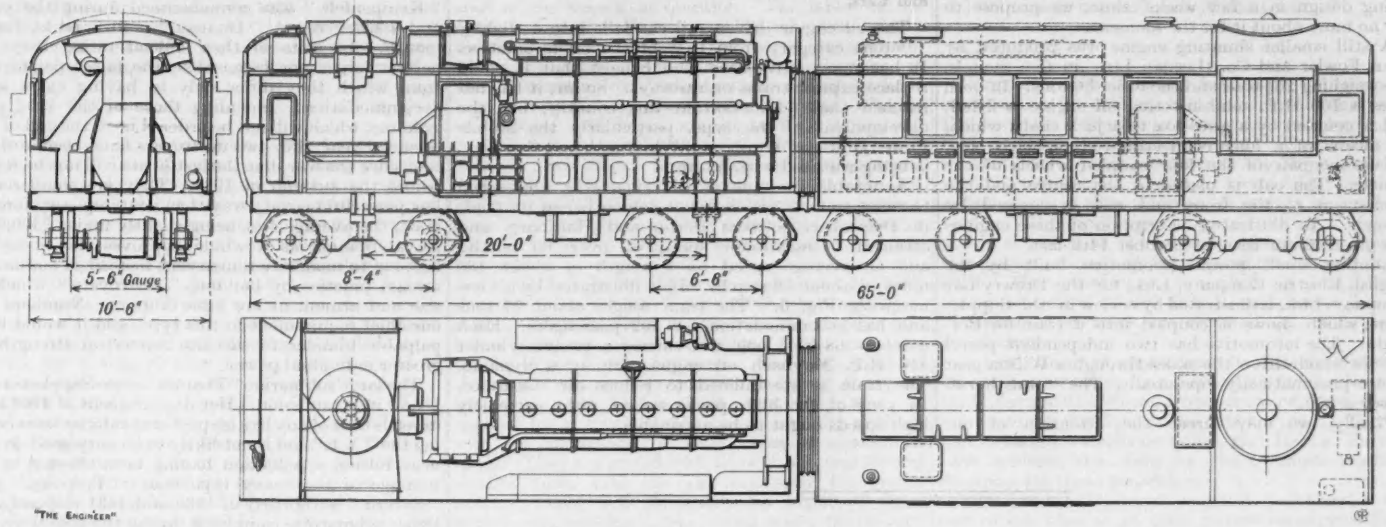


FIG. 3—ARMSTRONG-WHITWORTH MOBILE POWER-HOUSE

chester, and is coupled to an hydraulic pump which, in its turn, is coupled to an hydraulic motor on the jack shaft. A general arrangement is shown herewith—Fig. 4. This transmission gear, which was supplied by Haslam and Newton, Ltd., of Derby, is capable of infinite speed variation between zero and the equivalent of 25 m.p.h. The total weight of the locomotive is 46 tons 2 cwt.

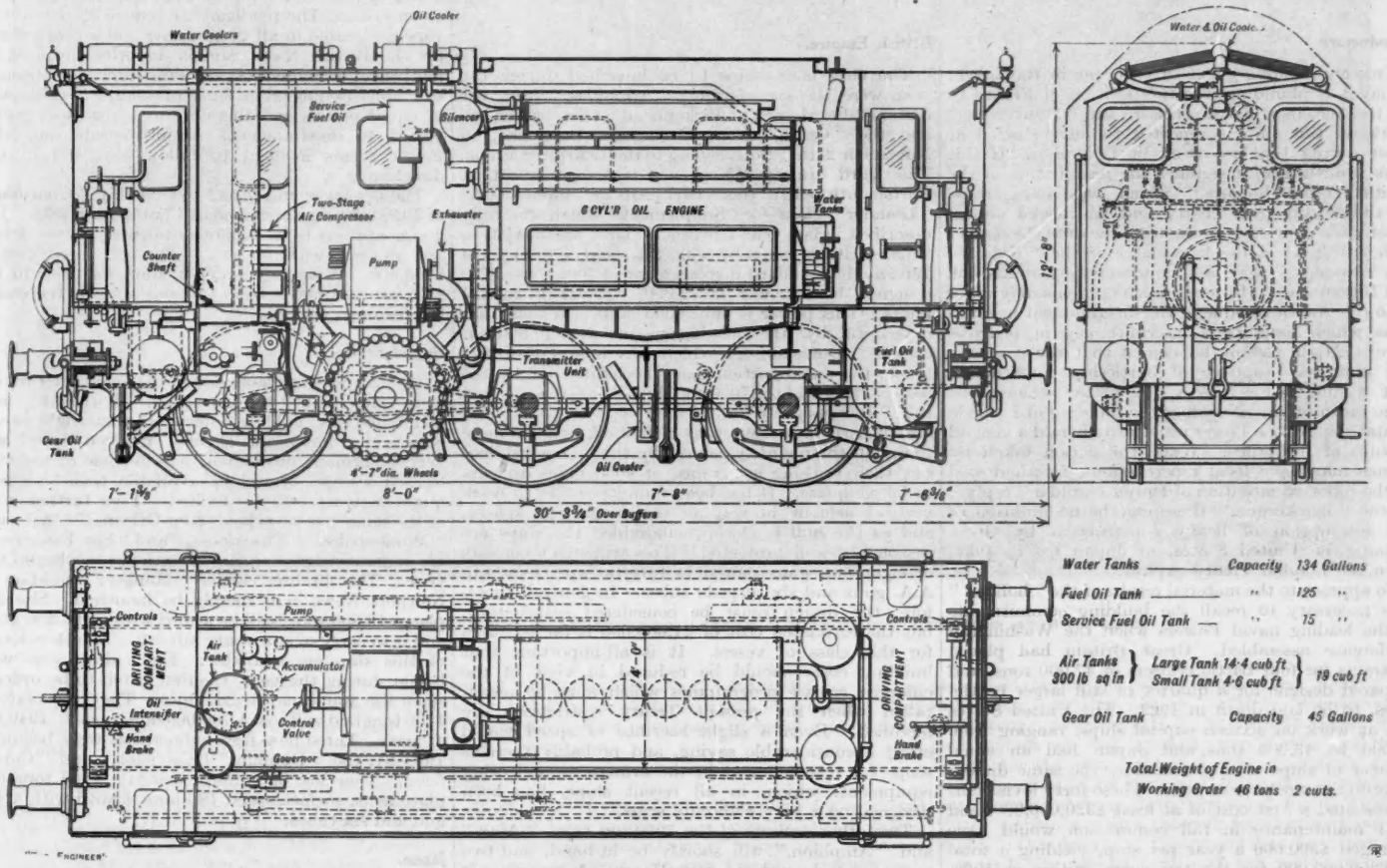


FIG. 4—L.M.S. OIL-HYDRAULIC LOCOMOTIVE

Another small oil locomotive of the year is one built by the British Thomson-Houston Company, Ltd., for the Ford works at Dagenham, where it will be employed for hauling trains of hot metal and slag. (See Supplement.) It weighs 44 tons, and can exert a maximum tractive effort of 24,000 lb., a tractive effort at one-hour rating (2 m.p.h.) of 14,000 lb., and a continuous tractive effort of 6200 lb. The engine is a six-

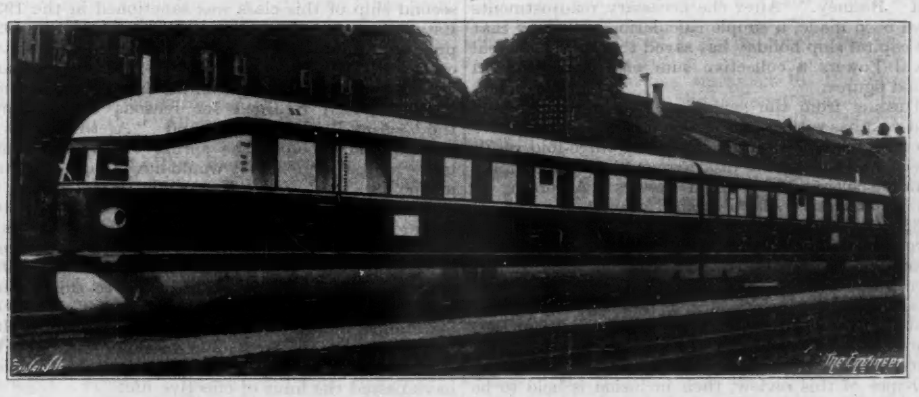


FIG. 5—GERMAN OIL-ELECTRIC TRAIN

cylinder Allen, developing 150 B.H.P. at 550 r.p.m., and is coupled to a B.T.H. direct-current generator, rated at 95 kW. There are two traction motors on each bogie. As we hope to deal fully with this interesting design in a few weeks' time, we propose to say no more about it for the moment.

A still smaller shunting engine was produced by John Fowler and Co. (Leeds), Ltd., in two models, one weighing 25½ tons and the other 30 tons. In both cases a 100 H.P. solid-injection oil engine is fitted, and is coupled by a gear-box to a jack shaft, which, by means of a long connecting-rod on each side, drives one pair of the four coupled wheels of the vehicle. The cab is placed in the centre and the mechanism at the front and rear is covered by bonnets. An illustrated description of these engines was given in our issue of October 14th last.

Another small power locomotive built by the English Electric Company, Ltd., for the Drewry Car Company, Ltd., is illustrated by a view in the Supplement, which shows it coupled into a train for Bermuda. The locomotive has two independent petrol engines which drive the axles through a Wilson gear electro-pneumatically operated. The total horse-power is 300.

Finally, we may direct the attention of our readers to articles in our issues of January 29th and December 23rd, in which the present position of the oil locomotive was reviewed.

Rail Cars.

The oil engine driven rail car falls into a slightly different category from that of the oil locomotive. It has many advocates who believe that it could replace express trains on railways. So far, it has not reached that distinction in this country, but the development of the type, particularly the Mobile Power House of Armstrong, Whitworth and Co., Ltd., is being watched with interest.

A notable example of the type is a high-speed German train of two coaches, which began its trials in December, between Berlin and Hamburg, and attained a maximum speed of over 90 m.p.h., and an average speed on a length of about 180 miles of about 76 m.p.h. It is illustrated by a view herewith, Fig. 5. The train weighs about 77 tons and has accommodation for 102 passengers. Each coach is 68 feet long and carries a twelve-cylinder 410 H.P. Maybach oil engine driving a dynamo. The train is streamlined to reduce air resistance. In view of the high power-weight ratio extremely high speeds ought to be attainable.

Naval Construction in 1932.

BY HECTOR C. BYWATER, A.I.N.A.

Introductory.

THE outstanding event of the year in the sphere of naval shipbuilding was the decision of France to lay the keel of a battle cruiser, the "Dunkerque." Work on this ship is reported to have started at Brest during the last week in December. If this news is authentic, it signifies the termination of the capital ship "holiday" which was inaugurated by the Washington Treaty and has lasted almost exactly ten years, reckoning from the date (December 28th, 1922) when the keel-plates of the "Nelson" and "Rodney" were laid simultaneously at Elswick and Birkenhead. However much opinions may differ as to the practical value of the disarmament negotiations which have been intermittently in progress since 1921, it cannot be denied that the complete and universal stoppage of battleship construction over a full decade was a diplomatic achievement of no mean order. Nor does the building of a single capital ship by one Power necessarily herald a general rupture of the truce. While the action taken by France may have local repercussions, foreshadowed by the reported intention of Italy to build a "reply" to the "Dunkerque," there can be no question of any resumption of heavy construction by Great Britain, the United States, or Japan before 1936, when the London Treaty expires.

To appreciate the material results of the "holiday" it is necessary to recall the building commitments of the leading naval Powers when the Washington Conference assembled. Great Britain had placed contracts for four battle cruisers of 47,000 tons, and prepared designs for a quartet of still larger battleships, to be laid down in 1922. The United States was at work on sixteen capital ships, ranging from 32,500 to 43,000 tons, and Japan had an equal number of ships of approximately the same dimensions on the stocks or *in petto*. These forty leviathans represented a first cost of at least £320,000,000, and their maintenance in full commission would have averaged £500,000 a year per ship, yielding a total of £200,000,000 for the ten years ending in 1936. But, as a result of the Washington Treaty, thirty-five of the projected ships were scrapped or cancelled, leaving only five intact—a total subsequently increased to seven by the building of the "Nelson" and "Rodney." After the necessary readjustments have been made, a simple calculation will show that the capital ship holiday has saved the three principal naval Powers a collective sum of £430,000,000 in round figures.

Turning from the general to the particular, the past year has witnessed a further decline in the relative strength of the British Navy as the three-fold result of economy, unilateral disarmament, and exceptional building activity by foreign Powers. According to official statistics, the British Navy at the end of 1932 stood fifth in destroyer and submarine tonnage—reckoning "under-age," *i.e.*, effective ships, only—and second in cruisers. It contains a far higher percentage of obsolete material than any other first-class navy, and its *personnel* is now 20,000 less than that of the United States Navy, and only 4000 tons more than that of the Japanese Navy. While these facts do not, strictly speaking, come within the province of this review, their inclusion is held to be warranted by the circumstance that the British Navy in 1933 is relatively less powerful than it has been at any time within the last two hundred years. That is a new fact which appears to justify some slight departure from precedent.

British Empire.

The only large ships to be launched during the year were the sister cruisers "Achilles," from the Cammell-Laird yard at Birkenhead on September 1st, and the "Orion," from Devonport Dockyard, on November 24th. Both belong to the 1930 programme. The third cruiser, "Neptune," is to go afloat at Portsmouth early this year. All are units of the "Leander" class—see Supplement—which was fully described in last year's review. They are 554½ft. in length, with a beam of 55ft. 2in., and a draught of 16ft. at the standard displacement of 7000 tons. The designed horse-power is 72,000, equivalent to 32½ knots. This power is only 8000 units less than that developed by the machinery of the 10,000-ton cruiser "Dorsetshire," which has a speed of 32¼ knots, the disproportion being accounted for by the reduced length of the 7000-ton ships—554½ft. as against the "Dorsetshire's" 630ft. The "Achilles" and her consorts stow 1800 tons of fuel oil, or little more than half the quantity carried by the "Dorsetshire," but their cruising endurance of 7000 miles appears to be adequate. It has been found possible to work vertical armour in way of the machinery spaces, and as the hull is closely subdivided the ships are reasonably well protected. The armament consists of eight 6in. guns paired in turrets, with four 4in. A.A. guns and six torpedo tubes. In general, therefore, the design must be considered satisfactory, but the estimated cost of £1,600,000 is far too high for this class of vessel. It is all-important that building costs should be reduced in view of the enlarged cruiser programmes which must be undertaken when the present Treaty restrictions are modified. Even a slight sacrifice of speed would effect a considerable saving, and probably there is scope for retrenchment in the armament and other equipment, which, in all recent ships, has been designed on a very elaborate scale.

Two other cruisers of the 7000-ton type, "Ajax" and "Amphion," will shortly be in hand, and two more are to be ordered next March. A new class is represented by the "Arethusa," now under construction at Chatham. From unofficial reports, she has a displacement of 5450 tons, the speed being 32½ knots, and the main armament six 6in. guns. A second ship of this class was sanctioned in the 1932 Estimates. Owing to the cancellation of the 1928 programme, and the delay in building the solitary cruiser ("Leander") authorised in 1929, no new cruiser was completed in 1932. As the 1931 programme has also been retarded for reasons of economy, the "Ajax," "Amphion" and "Arethusa" will not be ready before the spring of 1935, though, in the normal course, they would have been completed in the previous year. Meanwhile, large groups of war-built cruisers are becoming obsolete every year, but are not being replaced. At the present time only forty-three British cruisers are within the age-limit of sixteen years, and by the end of 1934 the total of under-age ships will have shrunk to thirty-four. If, therefore, our cruiser establishment is to be maintained at the total of fifty which the Admiralty has fixed as the irreducible minimum, it will be necessary to retain in service sixteen ships which have passed the limit of effective life.

Eight destroyers of the "D" class, built under the 1930 programme, went afloat during the year and are now passing into service. Except for a slight increase in tonnage, they are replicas of the "A," "B," and "C" boats, displacing 1375 tons, with machinery of 34,000 S.H.P. The contract speed has been raised from 35 to 35½ knots and was in every case exceeded on trial, the "Daring"—see Supplement—for example, reaching 38·2 knots on her full-power run. The flotilla leader "Kempenfelt" was commissioned during the year, and a sister vessel, "Duncan," is in hand at Portsmouth. In spite of their official rating they are neither larger nor faster than the latest destroyers, from which they differ only in having extra staff accommodation. Including those of the 1932 programme, which will not be ordered until the end of the financial year, fifty-two destroyers have been authorised since the war, but the last boats will not be ready before the autumn of 1934. They are smaller and less powerful in every way than contemporary foreign craft, the average cost being slightly under £300,000. Naval opinion as a whole approves the policy of keeping to moderate dimensions instead of emulating foreign practice by building "destroyers" which in size and armament are light cruisers. Numbers are our chief requirement in this type, and it would be a palpable blunder to sacrifice numerical strength to greater individual power.

The large submarine "Thames"—see Supplement—is now in commission. Her displacement of 1760 tons exceeds that of any British post-war submarine excepting the "X 1," and is not likely to be surpassed in the near future, a reduction having been effected in the tonnage of the heavy type boats "Porpoise" and "Severn," authorised in 1930 and 1931 respectively. Other submarines completed during the year were the "Swordfish"—see Supplement—and "Sturgeon," the first of a new coastal type introduced under the 1929 Estimates. Their displacement is only 640 tons, but they have proved remarkably seaworthy, and their armament of six torpedo tubes in the bow, besides a 3in. gun, is formidable. Four more of this class are building or on order. The tendency to reduce dimensions is very noticeable in all vessels now under construction for the British Navy, and is doubtless inspired by motives of economy. At the same time it deserves to be emphasised as an instance of qualitative reduction in naval power, and therefore as a practical contribution to disarmament. Unfortunately, no other Power seems inclined to follow our lead in this direction.

The net-layer and target-towing ship "Guardian," of 3050 tons, was launched at Chatham in 1932. Her design appears to be experimental, and further details are awaited with interest. The estimated cost is £406,900. A destroyer depôt ship, included in the 1932 programme, is to be ordered towards the end of the financial year.

United States.

The largest ships launched in the year under review were the 10,000-ton cruisers "Portland" and "Indianapolis." They differ from their eight predecessors by having a slightly reduced speed and vertical armour protection, but in view of the very limited margin of weight available their defensive qualities must still be limited. Five further ships of the same generic type, "New Orleans," "Astoria," "Minneapolis," "Tuscaloosa," and "San Francisco," are under construction, and a sixth is to be begun this year. The aircraft carrier "Ranger," building at Newport News, will shortly be launched. She displaces 13,800 tons, will be armed with eight 5in. guns, and is to carry over seventy aircraft. No other details of this ship are available. Eight destroyers were begun during the year, the first batch to be ordered since the war-time programmes. They are craft of 1500 tons and will cost 4,700,000 dollars each (£940,000 at par). Three new fleet submarines were begun in 1930–31, the "Dolphin," "Cachelot," and "Cuttlefish." They are of uniform design: 1560 tons displacement, surface speed 18 knots, armed with a 4in. gun and six tubes.

Japan.

Possibly as a result of the political situation in the Far East there was little news of Japanese naval developments in the past year. During the summer the "Chokai," the eighth and last of the 10,000-ton cruisers allotted to Japan by treaty, was delivered from the Mitsubishi yard. The type was fully described last year, and it need only be repeated that these ships incorporate a higher ratio of armament, protection, and horse-power than any other cruisers of equal tonnage. The aircraft carrier "Ryujo," of 7600 tons, is nearing completion at Yokohama. She represents an attempt to build a floating aerodrome of moderate tonnage, in contrast to the monster ships, up to 33,000 tons, now in service, which are not only very expensive to operate, but are dangerously vulnerable. Two cruisers of a new type were laid down in 1932. They are reported to be of 8500 tons and 33 knots speed, and will be armed with fifteen 5·1in. guns. This, curiously enough, is the same armament as that of the Russian cruisers of the "Profintern" class, which were designed before the war. The last destroyers of the "Fubuki" class (twenty-four units) were launched during the year. Displacing 1700 tons, with a contract speed of 35 knots, and mounting six 5·1in. guns and nine 21in. torpedo tubes, they are, in proportion to their size, the most heavily armed destroyers afloat. Five boats of modified design have been laid down, together with two 600-ton torpedo boats, of which no details are

known. A reduction has also been made in submarine dimensions, the three boats started during the year being of 1300 tons, as compared with 1638 tons in the preceding class. The following ships are projected and may be laid down in 1933 :—Two cruisers of 8400 tons, three destroyers, three submarines, a mine-layer of 5000 tons, three smaller mine-layers, two torpedo boats, five mine-sweepers.

France.

As noted in the introduction, the battle-cruiser "Dunkerque" has apparently been laid down at Brest, though the reports to this effect may refer to preliminary work rather than to the actual laying of the keel. In any case, however, the ship is assured of early construction. Although described officially as a counterweight to the German miniature battleships of the "Deutschland" class (10,000 tons, 26 knots, six 11in. guns), the "Dunkerque's" design indicates that a much broader view of her functions has been taken. After repeated modification the plans now provide for a ship of 26,500 tons, with a speed of 30 knots, and a main armament of eight 13in. guns in quadruple turrets, one forward and one aft. This novel method of mounting the guns has been adopted to save weight and concentrate protection. The four weapons in each turret are in two groups, divided by a bulkhead. Special attention has been given to the lay-out of the magazines, each of which has a capacity of nearly four hundred rounds of 13in. shell. To avoid bringing the shell and powder spaces too near the sides of the ship, where they would be liable to be affected by torpedo explosion, they are laid out longitudinally. The armour and underwater protection of the ship has been carefully studied, and it is predicted that the "Dunkerque" will be equal in fighting power to any battle-cruiser now in existence with the sole exception of H.M.S. "Hood." She is to be completed towards the end of 1935. Following the launch on May 21st, 1932, of the "Algérie," her seventh cruiser of the 10,000-ton class, France has reverted to smaller dimensions, and the new ships now on the stocks, "La Galissonnière" and "Jean-de-Vienne," displace only 7729 tons. The speed is to be 31 knots and the armament, nine 6·1in. guns in triple turrets, corresponding to that of the German 6000-ton ships of the "K" and "Leipzig" class. Four additional cruisers of the same type are to be laid down in 1933. A powerful cruiser-minelayer, the "Emile Bertin," is in hand at the Penhoët yard, St. Nazaire. She is 548ft. in length, with a displacement of 5886 tons, and a contract speed of 34 knots. Her armament is nine 6·1in. guns on triple mountings and she will carry several hundred mines.

All the flotilla leaders of the 1929 programme are now afloat. These formidable craft, which are really light cruisers, are purely French in conception, and no less than thirty-one have been built or ordered up to the present. The latest displace 2500 tons and are engined for 37 knots, the armament comprising five 5·5in. guns, five smaller pieces, and nine 21·7in. torpedo tubes. Several of the type have achieved phenomenal speeds on trial. The fastest to date is the "Cassard," with a maximum of 43·4 knots and a mean of 42·9 on a three-hour run, the displacement being 2646 tons. This vessel was built at the Chantiers de Bretagne at Nantes, and is fitted with Rateau turbines. The "Gerfaut" has attained 42·3 knots and the "Tartu" 41·2, the latter having to her credit an average of 38·58 knots for eight hours on a displacement of 2700 tons. These remarkable performances reflect high credit on the designers, constructors, machinery contractors, and engineering staff of the vessels in question. The latest official returns show that France has 109 submarines built, building, and authorised. The various types composing this impressive flotilla have been described in THE ENGINEER from time to time, and there have been no new developments in the past year. During the autumn a 5000-mile voyage to West Africa and back was made by the submarine-cruiser "Surcouf," without hitch of any kind. This vessel, the largest submersible in the world, is nearly 400ft. in length, has a surface displacement of 2880 tons and a maximum speed of 19 knots. She is the only underwater craft to be armed with 8in. guns, of which two are mounted.

A novel type of convoy sloop, or *escorteur*, has been developed, four of which are building and eight projected. They are ships of 600 tons, the speed is said to be high, and they mount four 3·5in. guns and several depth-charge throwers. The first group of "colonial" sloops was completed during the year. Displacing just under 2000 tons, they are oil-engined for a speed of 15½ knots, and are credited with an endurance of 9000 miles at economical speed. They are armed with three 5·5in. and several smaller guns, and are also equipped for laying mines. There will eventually be seven of these vessels, representing a type which might prove very useful to the British Navy, especially for convoy work and in view of the shortage of cruisers. They possess the further advantage of being exempt from treaty restriction.

Italy.

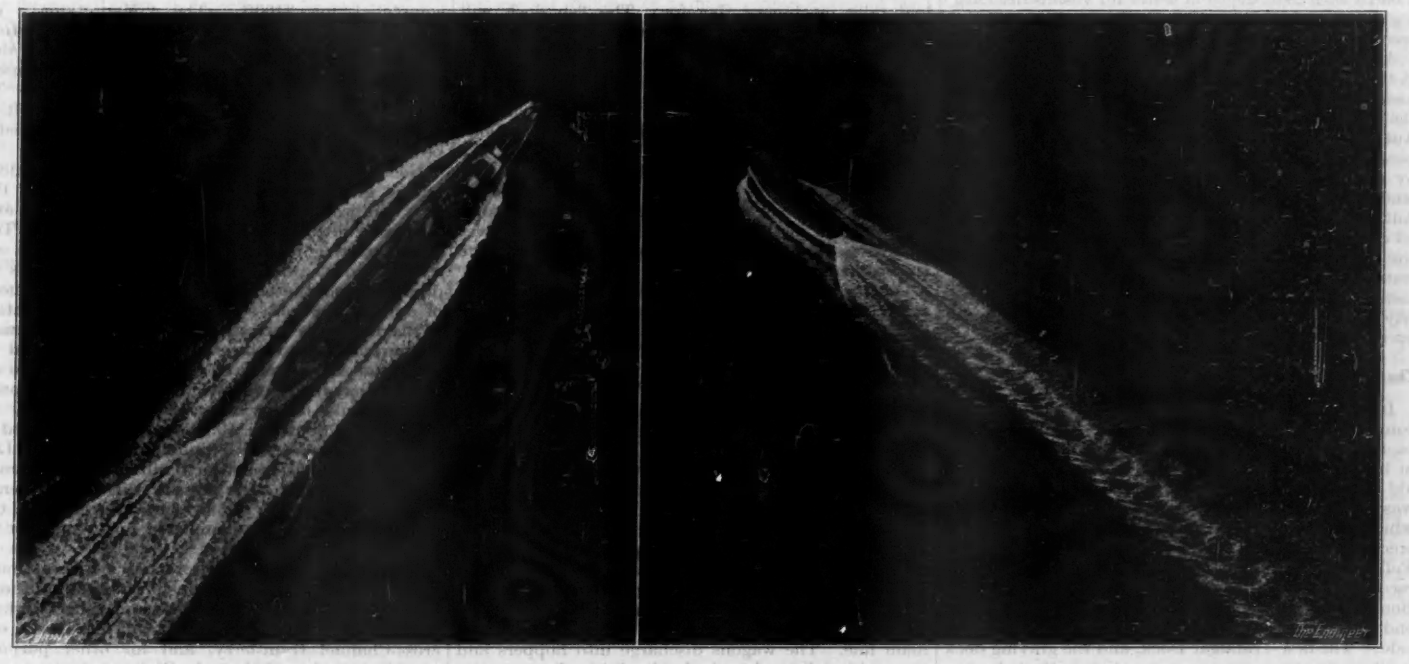
It is reported from Rome that plans for a capital ship have been prepared and various models tested in the experimental tank at Spezia, the inference being that a "reply" to the French "Dunkerque" is in contemplation. The "Bolzano," which went afloat in September, is the seventh and last cruiser of the 10,000-ton class. Unlike the four preceding ships, in which the speed was reduced to 32 knots to secure better protection, the "Bolzano" has been designed for 35·5 knots. Presumably, therefore, her defensive armour is very light. All six ships of the "Condottieri" class—5080–5090 tons, 37 knots, eight 6in. guns—are now afloat, comprising a homogeneous squadron of unprecedented speed On her trials the "Alberico di Barbiano" of this class touched 42·1 knots, the "Alberto di Giussano" reached 40·7, and others have approached 40 knots. An improved type of cruiser has since been developed, displacing 6700 tons with a contract speed of 38 knots —the highest yet recorded. Four of these ships were begun in 1931–32, and two more are due to be laid down in January or February, 1933. It is worthy of note that both France and Italy have made provision for nineteen cruising ships since the war, but while the French total includes a training ship ("Jeanne d'Arc") and two mine-layers ("Pluton" and "Emile Bertin"), all the Italian vessels are "straight" cruisers. The latest Italian destroyers are medium craft of 1225–1472 tons, and 38 knots, with a uniform armament of four 4·7in. guns and six to eight torpedo tubes. The single large funnel gives them an unusual appearance, but the housing of all boiler uptakes in one casing is an innovation which has many advantages and seems likely to be widely copied. In November, 1932, Italy had forty-six submarines completed and twenty-nine under construction, the latter ranging from ocean-going craft of 1390 tons to coastal boats of 636 tons.

Other Navies.

Germany's first "pocket battleship," "Deutschland," is due for delivery before the end of this year. The second, "Ersatz Lothringen," was begun at Kiel in June, 1931, and the third, "Ersatz Braunschweig," on October 1st, 1932. These ships, together with the new cruiser "Leipzig," were fully described in last year's review. The small cruiser, or artillery tender, "Bremse," was completed during the year. A ship of 1250 tons, she is chiefly remarkable as being the fastest oil-engined warship which has yet been built. Her machinery, described in last year's review, develops 25,000 B.H.P. and drives her at 27 knots. Her trials are reported as having been satisfactory.

A new cruiser of approximately 6000 tons, with a 6in. armament, is under construction for the Netherlands Navy at the Wilton-Fijenoord yard, Rotterdam. She is to be fitted with the latest type of Yarrow high-pressure water-tube boiler, and Messrs. Yarrow have received the order for the complete working drawings for these generators.

The Swedish "aircraft-cruiser" "Gotland," the first of her type to be built in any country, will be launched during the year. Particulars: Length on waterline, 426½ft.; beam, 47½ft.; displacement 5260 tons; designed S.H.P., 33,000=27 knots. She will mount six 6in. guns in two double and two single turrets, four light A.A. pieces, and six deck torpedo tubes. The after part of the ship is reserved for aircraft, stowage being provided for at least a dozen seaplanes, with a catapult for starting them on flight. The design of this vessel has been worked out with the utmost care, and her performance at sea will be watched with keen interest. The flotilla leader, "Dubrovnik," designed and constructed by Yarrow and Co., Ltd., was handed over to the Royal Yugoslav navy on May 14th. She has a length of 371ft., and was described in our issue of June 17th. An interesting feature of the trials was the taking of aerial photographs at 37 knots, two of which are reproduced on this page.



AERIAL VIEWS OF THE YUGO-SLAV FLOTILLA LEADER "DUBROVNIK" STEAMING AT 37 KNOTS

A grievous loss was sustained by the Spanish Navy in August, when the cruiser "Blas de Lezo" (closely resembling the British "D" class) was wrecked off Cape Finisterre. The only notable ship to go afloat was the 10,000-ton cruiser "Baleares," at Ferrol in April. In general design she resembles the British "County" class, but the uptakes are trunked into a single funnel, the horse-power is increased to 90,000 and the speed to 33 knots. The plans and much of the material are of British origin.

During December it was announced that the Portuguese Government had decided to place the following naval contracts with British firms :—Two first-class sloops with Hawthorn, Leslie and Co., Ltd., Hebburn-on-Tyne; three submarines with Vickers, Ltd., Barrow; one destroyer with Yarrow and Co., Ltd., Scotstoun. These orders, secured in the face of strong foreign competition, complete the entire Portuguese naval programme, several of the earlier units of which are also being constructed in British yards.

Harbours and Waterways in 1932.

NO. I.

THE complete change in the policy of the Government in relation to grants in aid of public works, which we recorded in our last annual review of harbours and waterways, has had its inevitable effect on the expenditure of money on capital works by port authorities in this country. Many of the grants from State resources promised before the change in policy took place have now been expended, although a few of the large works begun under the regime which continued until the summer of 1931 are still in course of construction. The paucity of Bills deposited in the present session of Parliament seeking powers for the construction of port works is probably unprecedented.

THE UNITED KINGDOM.

Port of London.

Compared with its activities in past years, the Port of London Authority in 1932 carried out an insignificant amount of works of improvement or development on capital account.

A new quay at the Royal Victoria Dock was begun in the autumn which, when completed, will provide a berth with 28ft. depth of water for vessels discharging cargoes of grain to the new flour mill now being erected on the south side of the dock.

A Bill promoted by the Port of London Authority in the last session of Parliament, after various amendments, received the Royal Assent. The clauses in the original Bill authorising the transfer to the Authority of various wharf undertakings on the river banks were dropped and the principal powers obtained by the Act relate to the compulsory acquisition of land and foreshore at Canvey Island, which the Port Authority proposes at some future time to utilise for oil discharge and storage. This is the only remaining site in proximity to the Mucking Light having a deep water frontage which is available for such development. It will be remembered that under the Authority's by-laws oil tankers are not allowed to proceed up the river further than the Mucking Light.

The Mersey and the Manchester Ship Canal.

In April the Mersey Docks and Harbour Board completed the modernisation of the Trafalgar Dock on the Liverpool side of the Mersey, which had been in hand for nearly two years. A few years ago the old Clarence Dock, constructed as far back as 1830, was acquired by the Corporation of Liverpool, by which it was filled in and the site utilised for the erection of the new municipal electric power station. Following on this change, the Trafalgar Dock was reconstructed and placed in direct water communication with the Gladstone Dock at the extreme north end of the Board's system of docks on the Liverpool side. The new Trafalgar Dock, and the graving dock built at the same time in connection with it, have a total water area of more than 7 acres and quayage 3000ft. in length. The new 60ft. wide passage from the Trafalgar Dock to the now adjacent Salisbury Dock is spanned by a rolling bascule bridge. The advantage of these new works is that they complete the navigable communication between the north and central series of the Liverpool docks. The largest vessels using the central docks are now able to reach their berths by entering the Gladstone Dock at any time irrespective of tide and then traversing the intervening docks. The distance from the Gladstone Dock lock through the intervening docks to the Prince's Dock is about 3¾ miles. The works were carried out departmentally by the Docks Board, at a cost of approximately £1,000,000. The Mersey Docks and Harbour Board in April placed an order for a new sand pump dredger with Cammell, Laird and Co., Ltd., of Birkenhead, to cost £103,000. The Dock Board recently decided to curtail the expenditure on the new Bidston Dock on the Birkenhead side of the river Mersey by reducing the length of the wet dock from 1600ft. to 1000ft. This modification will effect a saving of over £200,000. It is expected that the dock extension will be ready for use in March, 1933. Two of the four new bascule bridges which are being built for the Birkenhead extension have now been erected over the communicating passages, and are in use. The northward extension of the training bank on the west side of the Crosby Channel has been commenced and the work is being pushed on rapidly. The Board is also still engaged on the extension and raising of some of the other training banks in the sea approaches to the Mersey, including the Burbo training bank and the Taylor's Bank revetment.

The new oil dock which the Manchester Ship Canal Company is building at Stanlow is nearly completed. It adjoins the present oil dock built in 1922, but is of larger size, namely, 650ft. long by 180ft. wide, and has a depth of 32ft. The dock will be cut off from the canal water by a floating fire-boom and the approach to it and the adjoining dock, which has been excavated in the canal bank, will form an ample turning basin for ships using this part of the canal. Work is also proceeding on the construction and equipment of the coal and ore wharf, 600ft. in length, to serve the works of the Lancashire Steel Corporation situated on the canal bank at Irlam.

In January the death occurred of Thomas Monk Newell, formerly the engineer in chief of the Mersey Docks and Harbour Board, who, in the course of a career extending over nearly half a century, constructed many dock and port works of great magnitude, particularly at Hull and on the Mersey.

North-East Coast and Humber Ports.

The fish dock at Grimsby, begun by the London and North-Eastern Railway Company in 1930, is still far from completion. The contractors have experienced difficulties in the construction of the foundations for the new lock, the underlying strata having proved to be more unstable than had been expected. The reclamation embankment enclosing the new dock area has been completed and a large area behind it has been filled in. The building of the entrance jetty has been begun, and a contract has been placed for the three pairs of lock gates and the hydraulic machinery therefor. The fish dock will provide 4000ft. of additional quays, ten slipways for the repair of fishing boats, and will add 37 acres of water space to the existing dock accommodation reserved for the fish trade of the port. The new coal-shipping plant which the railway company has provided on the site of an old staith in the Royal Dock at Grimsby is now practically completed. We referred to this interesting work in our review last year. It is one of the most complete and best-equipped conveyor belt installations for the shipment of coal in this country. The scheme involves extensive alterations to the railways which will serve the coaling jetty.

On the Tyne, Swan, Hunter and Wigham Richardson, Ltd., are replacing their present floating dry dock by a new graving dock, which will be large enough to accommodate the biggest vessels visiting the Tyne. The new dock, begun in November, is being constructed on a site near the firm's other two graving docks at Wallsend. The contract for the work has been given to Sir Robert McAlpine and Sons, Ltd., and the estimated cost is £200,000.

The Tyne Commissioners' new coal staith on the riverside at the west end of Northumberland Dock, was brought into use in December. There are two loading berths in the river as to the use of which the Hartley Main Collieries have a preference, but they are also available for the shipment of coal from other collieries. The standage sidings which have been constructed by the colliery company connect with the London and North-Eastern Railway Company's main line. The wagons discharge into hoppers and the coal is delivered to the holds of ships by conveyor belts. The length of the jetty parallel with the river is 750ft. An illustrated description of the staith will be found in our issue of December 23rd, 1932.

Work on the extension of the Newcastle Corporation's Ouseburn Quay is still in progress. The extension is not likely to be ready for use before the end of 1933.

The deep water quay in the river Wear, which the Corporation of Sunderland is building with the assistance of a grant-in-aid from the Treasury, is expected to be ready for use some time this year. In connection with this quay coal-shipping appliances for use in bunkering ships are being constructed by the River Wear Commissioners. The new quay is founded mainly on a series of concrete monoliths sunk into the bed of the river, and, in order to provide the required depth of water in the berths in front of it, a large amount of rock dredging has been done. The Wear Commissioners have now completed the major portion of the protection work on the outer face of the South Pier at Sunderland, which they began over a year ago. This protection takes the form of the deposit of large quantities of rock rubble, the pieces ranging from 10 tons downwards, to form a talus which will protect the foundations of the pier structure from erosion.

Forty-six new electric cranes are included in the re-equipment of the Middlesbrough Dock on which the London and North-Eastern Railway Company has been engaged for over a year; £200,000 is being spent at Middlesbrough on the complete remodelling of the dock plant.

The Humber Bridge Bill, which passed a Committee of the Commons in May, 1931, and was carried over into the 1932 Session of Parliament, failed to proceed further owing to the withdrawal by the Government of the offer of substantial financial assistance which had previously enabled the scheme to be put before Parliament. It will be remembered that the Bill was strenuously opposed in Committee by the Humber Conservancy Board and other important navigational and shipping interests, and it is now unlikely that it will be revived for some time to come.

The London and North-Eastern Railway Company is installing nineteen electric cranes at the Alexandra Dock, Hull, the equipment of which is being modernised. Some of the old coal hoists at Hull are being altered to take 20-ton wagons, and at the St. Andrew's Fish Dock 1600ft. of quayage is being reconstructed and widened.

At Goole, the London, Midland and Scottish Railway Company completed the remodelling of a part of the shipping facilities at the West Dock, which belongs to the Aire and Calder Navigation. The new equipment provided by the railway company includes a transit shed over 500ft. long, additional sidings and a number of electric cranes on the quayside and in the shed.

It is stated that another two years will be required to complete the river training works at Trent Falls, where the rivers Trent and Ouse unite to form the Humber.

Southern Railway Ports.

The first section of the new quay wall in the river Test at Southampton, 3800ft. in length, was brought into use by the Southern Railway Company during the autumn of 1932, since when the berths have been used as lay-bys by Cunard and other Transatlantic liners, some of which have also been fitted out while lying alongside the quay wall. The quay and the new transit sheds, each of which is 1000ft. in length, have not yet been used for goods or passenger traffic. It is, however, expected that such use will begin early in the New Year. The dredging of the berths to a depth of 45ft. at low water has been completed for 3400ft. The "Mauretania" was the first liner to be berthed at the quay, on October 19th, but before that the Southampton floating dock had been moored alongside while the berth ordinarily occupied by the dock was being re-dredged. The second section of the deep water quay, 3600ft. in length, has made rapid progress, and is expected to be completed towards the end of 1933.

Good progress was also made with the building of the great dry dock begun at the end of 1930 near Millbrook Station at the west end of the area, 400 acres in extent, reclaimed from the river Test. An interesting feature in connection with the construction of the dock is the series of tube wells put down around the site of the excavation by means of which the sub-strata under the foundations of the dock have been so far relieved of water pressure by pumping as to allow of the excavation and the deposition of concrete to be carried out in the dry and without exposing the work to the risk of "blows" which would otherwise have been inevitable. In August the Southern Railway Company placed an order with the Furness Shipbuilding Company, Ltd., for the sliding caisson which will close the entrance to the dry dock. The caisson will have a length of 142ft. and a depth of 58ft. 6in. It is expected that the dry dock will be completed and ready for use during the coming autumn.

The Southern Railway Company's Bill, promoted in the last Session of Parliament to obtain authority for the construction of a dock and other works in connection with the establishment at Dover of a cross-Channel train-ferry, and for other purposes, was the occasion of the only Parliamentary proceedings relating to a harbour Bill of any importance during the year under review. Certain proposals contained in the Bill relative to the coal traffic at Dover were opposed both in the Commons and in the Lords by the Dover Harbour Commissioners and other authorities, the main grounds for the opposition being the increase in the coal traffic that would pass over the sea-front railway to the eastern arm breakwater if the powers sought were granted. The Bill finally passed the Lords Committee with a condition limiting the tonnage of coal to be carried over the sea-front railway to 300,000 tons per annum. No important opposition was offered to the railway company's proposals for the construction of a small dock at Dover and the provision of a train-ferry. The Southern Railway Company announced in November its intention to introduce the train-ferry service authorised by the Act of 1932 and to have it ready for operation in the summer of 1934. Three train-ferry vessels are to be constructed and these will ply between Dover and Dunkirk. The small wet dock to be built at Dover in connection with the ferry service will lie between the Admiralty Pier and the South Pier of the inner harbour.

The new coal-shipment plant which the Southern Railway Company has provided on the eastern arm of Dover Harbour was brought into use in April, when a cargo of Kent coal was shipped. This plant is served by the sea-front railway, which was the bone of contention throughout the proceedings before the Parliamentary Committees in April and June. It consists of a side wagon tippler, similar to those recently established by the London, Midland and Scottish Railway, referred to hereunder, from which the coal is fed on to a system of longitudinal conveyors and thence to the ship by means of a travelling loading-tower and a movable boom conveyor. This plant is capable of loading run-of-the-mine coal into ships at the rate of 500 tons an hour. We published an illustrated description of this plant in our issue of December 2nd, 1932. It will be remembered that, in addition to the Southern Railway Company's coal-shipping plant on the

eastern arm, there is an aerial ropeway and coal-loading plant which is owned and operated by the Tilmanstone Colliery Company also on the eastern arm, but at a point nearer the outer end of the breakwater than the railway company's installation. This, as mentioned in our review published two years ago, was brought into use in February, 1930.

Work on the removal of the two block-ships sunk at the western entrance of Dover Harbour during the war, was begun in the spring of 1931, and was continued during the year.

South Wales Ports.

The Great Western Railway Company carried on throughout the year its programme for the modernisation of the equipment of the South Wales docks, and in the list of proposed new works which the company prepared for 1932 an expenditure of £575,000 was provided for in this connection. A large part of this expenditure was devoted to the provision of new coal shipping appliances at Cardiff and Swansea. In June the railway company announced that it proposed to close down the Penarth Docks with the object of effecting economies in working and in view of the serious falling off in the tonnage of coal shipped at the South Wales ports. In response, however, to the protests of local traders, the railway company in August agreed to defer the closing of the docks for twelve months.

The last of the new equipment of traversing coal hoists on the south-east quay of the Queen Alexandra Dock at Cardiff was completed in June. There are now nine of these hoists, all of them movable on a quay frontage 1500ft. in length and served by electrically operated wagon traversers at quay level. The new belt conveyor coal shipping appliance at the Roath Dock, Cardiff, to which we made reference a year ago, is now in use and several coal anti-breakage appliances have been provided at Cardiff and Swansea, in addition to a Norfolk " digger " at the Cardiff East Dock. This appliance, designed to speed up the shipment of washed duff coal, especially in winter time, when such coal is not infrequently frozen up, is the first of several which have been ordered by the company for use at its coal hoists in South Wales.

Scotland.

The Leith Dock Commissioners are building a grain elevator and store house plant at the Imperial Dock to take the place of the structure destroyed by fire early in 1930. All the contracts for this installation, including the provision of the mechanical appliances and belts, have now been placed and the granary will have a capacity of 20,000 tons of grain.

We referred last year to the London, Midland and Scottish Railway Company's large programme of improvements at its coal ports, including the provision of eight electric conveyor belt installations for shipping coal at Glasgow, Ayr, Troon, and Grangemouth, in addition to one at the company's terminal at Swansea. At that time only one of these installations was in use, namely, that at the General Terminus, Glasgow, but since then the plant at the Carron Dock, Grangemouth, as well as one of three to be provided at Ayr, has been brought into use. Provision has been made in all these plants for side-tipping coal wagons. No turntables are required, the wagons running through the tipping platform on to the gravity road. The plant at Grangemouth has a maximum capacity of about 700 tons per hour and that at Ayr 600 tons. The railway company is also engaged on the complete electrification of the harbour plant and crane equipment at Ayr.

The Clyde Navigation Trustees are still busy with the reconstruction of quays on the river banks, mainly with the object of providing increased depth of water. Thus the Plantation Quay is being rebuilt and widened with a low water depth of 24ft. alongside, in comparison with the 15ft. available before the improvements were made. One-half of the reconstructed quay wall was founded in a trench excavated by grabs within two lines of sheet piling; but this method was found impracticable, owing to the nature of the foundation, in the case of the second half of the work, which is now in progress, and caissons 75ft. in length by 25ft. wide, have been sunk by compressed air to a depth of 56ft. below coping level. These caissons are sited in front of the old quay wall. The cost of reconstruction of the Plantation Quay is estimated at £115,000. The Trustees have abandoned for the present the proposed erection of a new goods shed at the General Terminus Quay. In August the Clyde Trustees decided to close temporarily the Rothesay Dock as a measure of economy in view of the present trade depression. It will be remembered that this is the principal coal and mineral basin under the control of the Trustees.

The Clyde Trustees No. 3 Graving Dock, which was opened in 1898 and is the largest on the river, has been deepened on the floor by 20in., thus permitting the full depth of 26½ft. on the sill at high water of spring tides to be made use of. Hitherto this was not possible owing to the blocks being at a higher level than the sill. The new electric fitting-out crane at Stobcross to lift 175 tons is now in use. The crane is of the hammer-head type and lifts the maximum load at a radius of 85ft. and 80 tons at a radius of 144ft.

The widening of the river Clyde at Clydebank for the new Cunard liner had already been completed just before the suspension of work on the vessel in December, 1931, but the considerable dredging in the neighbourhood of the building berth, which will be necessary before the ship can be launched, was postponed indefinitely.

The new dry dock at Elderslie, Scotstoun, which Sir Robert McAlpine and Sons are building for Barclay, Curle and Co., Ltd., is now practically completed. The entrance, 85ft. in width, is closed by a hinged flap gate turning about a horizontal axis below sill level. The new dock has a length of 620ft. and the available depth over sill at M.H.W.S.T. is 28ft. The Greenock Harbour Trustees' dry dock at Garvel, near the mouth of the river Clyde, has been enlarged by the reconstruction of the entrance, the effective width of which has been increased from about 50ft. to 69ft. The dry dock, after being out of use for several years, was reopened for use in November on the completion of the reconstruction works.

Ireland.

In the last weeks of November there appeared in several British and Irish journals descriptions of a project for the construction of a great Transatlantic port on the West Coast of Ireland at Galway. This scheme is by no means a novel one. It has been brought forward at intervals during the past twenty-five years, but, in its latest form, there is incorporated with it a proposal for an air port to be operated in conjunction with the harbour for the rapid transit of mails between Europe and America. There does not seem much hope of this project, estimated to cost several millions of pounds, materialising in the near future. At the same time the Galway harbour authorities are seeking powers in the present session of the Free State Parliament for the carrying out of certain works of improvement on a modest scale in their dock at Galway.

The harbour extension scheme on the County Antrim side of the river at Belfast is nearing completion, and the first vessel was berthed in the new North Channel in July. The large open basin, which is approached by the new channel from Belfast Lough, is being dredged to a depth of 30ft. at low water.

Other Ports in the United Kingdom.

Progress was made by the London and North-Eastern Railway Company with the extension of Parkeston Quay at Harwich, begun in October, 1931. The work, which is not expected to be completed until towards the end of 1933, will provide additional berthing for three ships, the new quay having a length of 1200ft. with additional marshalling sidings and transit sheds. The railway company was also engaged on the improvement of harbour facilities at Mallaig. No progress appears to have been made by the London, Midland and Scottish Railway Company in the carrying out of the works at Fleetwood, authorised by Parliament in 1931. These include a new dock and lock entrance and other works for the use of the fishing fleet and were estimated to cost about £750,000.

The Shoreham Harbour Trustees completed the building of the new and larger lock at the entrance to their wet dock at Shoreham, but this has not yet been opened to traffic as a considerable amount of dredging and other work remains to be done before the new entrance can be made available.

Harbour improvements at Seahouses, a small fishing port on the Northumberland coast, were begun in September, the cost, estimated at £21,000, being met mainly by a grant from the Development Fund. Improvement works at the fishery harbour of Anstruther, in Fife, which have cost about £20,000, are nearing completion. At Nairn a programme of harbour reconstruction work, which has been carried out during recent years, at a cost of about £47,000, was completed, and a new basin for the accommodation of drifters is now being constructed. A new patent slipway for fishing boats, opened at Peterhead in the summer, marked the completion of the improvements at the fishery harbour on which upwards of £78,000 have been expended in recent years.

Inland Waterways of the United Kingdom.

The Grand Union Canal Company began during the year a large programme of improvements on the canals between London and Birmingham. A series of new and deeper locks is being constructed to take the place of a larger number of shallow locks near Daventry and Foxton, and in some other localities. It will be remembered that the Canal Company obtained parliamentary powers in 1931 for improvement works which will ultimately involve an expenditure of about £1,000,000. On January 1st, 1932, the Old Leicester Navigation, the Loughborough Navigation, and the Erewash Canal, in all about 40 miles of waterways, became incorporated in the Grand Union Canal Company under the provisions of the 1931 Act, and the work of improving these partially moribund navigations was begun shortly afterwards. By means of dredging, widening and other works, they will be improved to the standard adopted for the Canal Company's main waterways.

The Trent Navigation Act, obtained by the Trent Navigation Company in the last session of Parliament, provides for the extension of the improvement of the river Trent above Nottingham, including the construction of two new locks. When the works authorised by the Act are carried out, barges carrying 120 tons of cargo, which cannot now proceed higher up the river than Nottingham, will be able to navigate for several miles beyond that place. The Corporation of Nottingham, in view of the shortage of quay accommodation for barges in the vicinity of the city, is constructing a large basin alongside the river bank. The cost of this work, inclusive of the necessary transit sheds and equipment, is expected to amount to £60,000.

The Ministry of Transport, which is responsible for the Crinan Canal, is expending £60,000 on a new sea lock at the Ardrishaig entrance to the canal and the extension of the lock at the Crinan entrance. The new Ardrishaig lock will enable vessels to enter the canal at all stages of the tide. This has not hitherto been possible.

(To be continued.)

Electrical Engineering in 1932.

BAD as things were generally during the period under review, conditions in the electrical industry might have been very much worse. From some of the reports that have been sent to us by manufacturing firms, one might almost imagine that the past year was a period of considerable prosperity. But it is to be remembered that for the most part electrical work is carried out in this country by large concerns, and even when business is far from ideal, they can point to orders which, without consideration of the productive capacities of their factories, make things look a good deal better than they really are. Nevertheless, with " grid " and frequency standardisation work still in progress, the poor supply of other important jobs was, to some extent, compensated, and the industry was not affected to the same extent by the slump as many others. According to Beama statistics, production was steadier during 1932 than it was in the previous year, and unemployment began steadily to decline from its peak after the month of April. But, on account of the general collapse of development work, orders continued to fall, although, on the export side, there was a slight rally towards the end of the year. The most important foreign contracts were for suburban railway electrification in Denmark, and for the new State power station in Montevideo, while among the important orders for plant for service in this country, were those for generating sets for Fulham, Swansea, and Brighton. The market for light apparatus considerably improved, and once again the figures for electricity generation augmented, those for January-October showing a 7 per cent. increase over those for the corresponding period of 1931. But, in view of the facts that the consumption of electricity in this country has long been below that of many other countries, and that large sums of money have recently been spent on increasing the availability of electricity, the improvement in the units generated is not really very extraordinary. Over the export figures for January, those for October showed a satisfactory increase, but during the worst period of the depression production throughout the industry was estimated to have declined by about 30 per cent. as compared with that of the preceding year. The decline, however, now appears to have been definitely checked, and as far as it is possible to estimate, production, particularly in light apparatus, is tending to increase, although there is some way to go before the output of 1930 is reached.

Statistics.

As is well recognised, the statistics issued by the Electricity Commissioners necessarily lag behind the times, and those now available cannot be used to show the true state of affairs up to the end of December. Some of the statistical returns for the year 1931–32—*i.e.*, the year ended March 31st, 1932, in the case of local authorities in England and Wales, May 15th, 1932, for Scottish local authorities, and December 31st, 1931, for companies—are still outstanding; but the following approximate figures are not without interest. The total capacity of plant installed up to the end of the year 1931–32 was 7,170,000 kW, compared with 6,946,000 kW at the end of the previous year, thus showing an increase of 224,000 kW, which was accounted for by the installation of 385,000 kilowatts of new plant and the shutting down of 161,000 kW of old plant. What the total capacity of the plant amounted to at the end of 1932, the Commissioners do not at present know. Nineteen stations were closed

down during the year, and one new power-house was put into operation in September, namely, the 50,000 kW station at Ironbridge, which will have an ultimate capacity of 200,000 kW.

Central Electricity Board.

The outstanding works completed by the Central Electricity Board were the erection of the Thames crossing towers—Fig. 1—together with other river crossings, particularly in South-West and North-West England, the Upper Arlington crossing, in the latter, with two towers 194ft. high, and with a span of 1600ft., being, perhaps, the most interesting. Other important items of work were the installation of the first 132,000-volt metal-clad outdoor switchgear at Tongland, in South Scotland, the installation of the first large-scale English Electric induction regulators at Finchley, and the manufacture for the Board of two 75,000 kVA transformers for the Clarence Dock sub-station by Ferranti Ltd. The control rooms for Central Scotland, Mid-East England and Central England were completed, while sufficient progress was made in the construction of the Bankside control room to ensure that it will be ready for use sometime in the spring of 1933.

As far as primary lines are concerned, the "grid" was complete in Central Scotland, South Scotland, North-East England, North-West England, Mid-East England, Central England, and East England, but at the end of November, there were still 56 miles of lines to be erected in South-East England, and 142 miles in South-West England. With the exception of the New Forest section, all the wayleaves for the scheme were obtained. Secondary line construction work was completed in Central Scotland, North-East England, Mid-East England, Central England, and East England, but there were still 17 miles to be dealt with at the end of November in North-West England, 61 miles in South Scotland, 17 miles in South-East England, and 93 miles in South-West England. For the entire national overhead scheme 400 miles of secondary lines remained to be dealt with at the end of November. During the eleven months of the year, 1180 miles of overhead lines were constructed, and 417 miles of wayleaves negotiated, leaving only 20 miles of wayleaves outstanding in the whole country. Out of a total of 134 miles of cables required, 99 miles were completed and tested in South-East England, so that, including cables, the total length of the "grid" constructed was about 3579 miles. At the end of October, the total value of the contracts awarded by the Board for the construction of the "grid" was £23,895,000, as compared with £21,849,000 at the end of 1931, and primary lines accounted for £16,580,000. The amounts sanctioned by the Board in connection with the standardisation of frequency totalled at the end of October slightly over £10,000,000, making the total expenditure sanctioned for the construction of the "grid" and standardisation about £34,000,000. Contracts for generating plant and other equipment were placed by the authorities concerned for the capital stations at Fulham and Tir John North, whilst considerable progress was made with the water power sets for the Galloway scheme.

Generating Plant.

Whilst the Ironbridge station illustrated in one of our Supplements to-day was the only large station opened during the year, several others are nearing completion. The Battersea station, briefly described in our issue of December 2nd, should be ready for running in about two months, while the Barking extension, which really constitutes an entirely new and separate power house, should be working a little later. The exterior view of the former, given in our Supplement, in no way represents the appearance of the building to-day, as it is from a photograph taken as far back as last August, when the erection of the second chimney had only just been begun. Now the building, or rather the first section of it, is practically complete, and the initial plant, consisting of two 67,200-kW sets, together with suitable boilers, &c., has been installed. Space is available for a third unit of the same capacity, but when load has been found for the three sets, the building illustrated will be extended to the right to enable it to accommodate approximately 450,000 kW of plant.

Unlike the original Barking station, the new station adjacent to the first building is devoid of "frills," for there are no pulverised coal or reheating equipments. There are two 75,000-kVA (M.C.R.) turbo generator sets, built by the Metropolitan-Vickers and British Thomson-Houston companies, the stop valve pressure being 600 lb. per square inch, and the temperature 800 deg. Fah. For operating these sets, eight Babcock boilers, with a normal rating of 205,000 lb. per hour and a maximum rating of 256,000 lb. have been installed. The working pressure is 625 lb., and the temperature 840 deg. Fah. The new Dunston Station must now also be nearly ready for service.

Another station which will shortly be opened is Blackburn Meadows of the Sheffield Corporation, for which the English Electric Company has built a 20,000-kW turbo-generator set. Most of the excavation work for the new Fulham station is well in hand, and contracts for the retaining walls and foundations were recently placed. Orders have also been given for two 75,000-kVA turbo-alternator sets with condensers and auxiliary plant, as well as for boilers and auxiliaries.

Among the additions to existing stations was a new 25,000-kW, 33/36-kV, Parsons alternator installed at the Brimsdown station, in which another machine of the same kind has been in operation for some years. As readers of THE ENGINEER are well aware, orders for four more 33/36-kV Parsons alternators for various power stations, including two for Swansea, were placed during the past twelve months. Among the orders for Parsons machines generating at ordinary voltages was one for a 30,000-kW set for Brighton, designed for a pressure of 650 lb. per square inch and a superheat of 850 deg. Fah. Neglecting the less important sets for which this firm received orders from the Dominions and elsewhere, the largest machines which left the Heaton works were the three 50,000-kW sets for the Dunston power station, the last machines with which Sir Charles Parsons was concerned before his death. Details of these sets will be found in our issue of November 20th, 1931. Two 36,000-kW Parsons units were completed for Copenhagen; a 30,000-kW unit, as illustrated in our Supplement, was put into operation at Hackney; a 20,000-kW unit at Congella; an 18,750-kW unit at Lot's-road; and a 12,500-kW set at Pretoria; not to mention many smaller machines.

The Battersea machines were built by the British Thomson-Houston and Metropolitan-Vickers Electrical companies, the latter firm having also secured the order for the Fulham machines. Many self-contained high-pressure and pass-out Metrovick turbines of relatively small size were ordered, and a considerable amount was done in the way of altering machines to make them generate at standard frequency.

Among the English Electric machines that were delivered or set to work during the year are a 30,000-kW unit for the Thornhill station of the Yorkshire Electric Power Company, two 10,000-kW back-

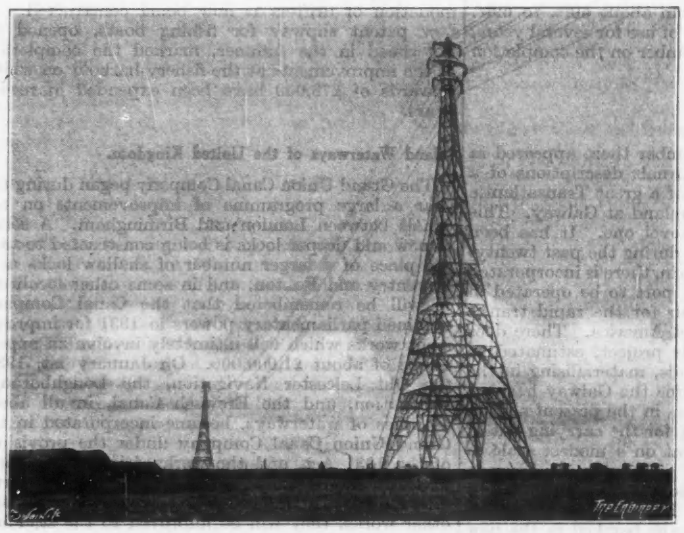


FIG. 1—THAMES TRANSMISSION LINE CROSSING

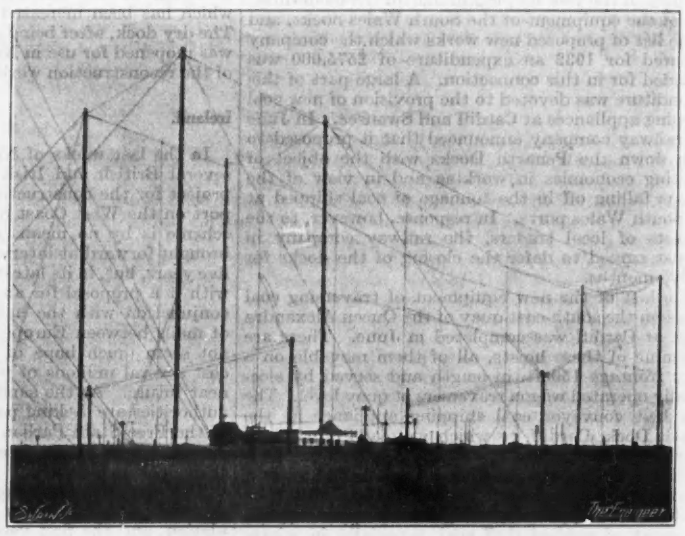


FIG. 2—WEST AFRICAN AERIAL ARRAY

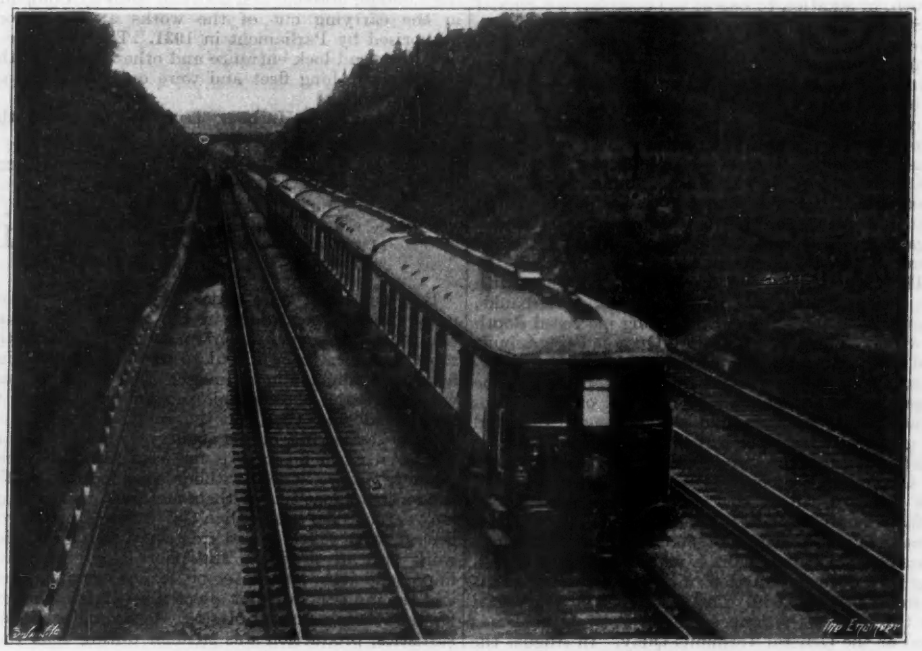


FIG. 3—"SOUTHERN BELLE" ELECTRIC TRAIN

pressure units at the Yallourn Briquetting Works of the Victoria State Commissioners, Australia, a 15,000-kW unit for the Polish Government, and a 10,000-kW set for the Hayle station of the Cornwall Electric Power Company. Besides other machines under construction, the firm is manufacturing three 15,500 H.P. and two 16,800 H.P. water turbine alternators and auxiliaries for the Galloway Water Power Company.

Apart from the Barking and Battersea machines referred to earlier, the British Thomson-Houston Company built and erected the 50,000-kW set in the Ironbridge station, and is now erecting the well-known 1200 lb. pressure, 30,000-kW turbo-alternator in the Dagenham works of the Ford Motor Company. Solid rotors for 3000 r.p.m. were redesigned with a view to improved ventilation, and successful tests were carried out on a 37,500-kVA set with an improved rotor for the Spondon power station of the Derbyshire and Nottinghamshire Power Company; an 18,750-kVA machine for the Norwich Corporation; and one of 12,500-kVA capacity for the North Metropolitan Electric Power Company.

The General Electric Company experienced a very fair demand for generating plant driven by pass-out turbines for use in places where there is a demand for process steam.

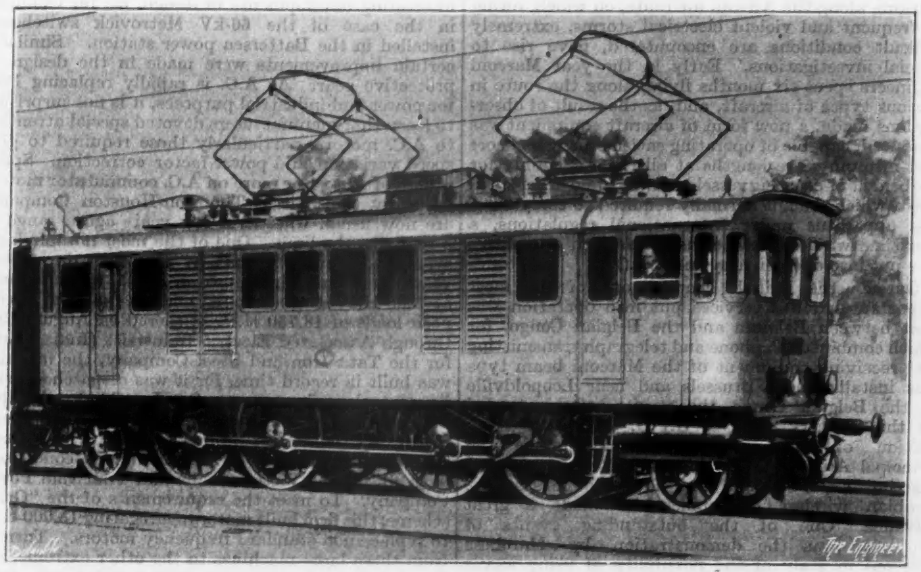


FIG. 4—FIFTY CYCLE SINGLE-PHASE LOCOMOTIVE

Electric Traction.

The outstanding event in the field of electric traction was the completion of the Southern Railway's electrified line from London to Worthing, opened last week. For many years this scheme has been under consideration, and last July electric working was begun as far as Three Bridges, where the control station, shown in our Supplement, has been erected for the remote control of eighteen rectifier sub-stations equipped by Brown, Boveri, Bruce Peebles, and A.S.E.A. Electric Company, Ltd. Each of the eighteen sub-stations which serve for the complete scheme contains a 2500-kW Brown-Boveri rectifier designed for a D.C. pressure of 650 volts, the power supply for the line being taken from the "grid" system at three points through English Electric 132-kV switchgear. The ordinary trains are equipped with Metrovick motors, control gear, and heating apparatus, while the equipment for the express service rolling stock—see Fig. 3—was made by the British Thomson-Houston Company.

The Barking-Upminster line of the London, Midland and Scottish Railway, consisting of two additional tracks with sub-stations at Upney, Heathway, Hornchurch, and Upminster, and having an approximate length of 7¾ route miles, was put into operation in September. For this scheme rectifiers made by the B.T.H. Company and the General Electric Company are used in two of the sub-stations, the remaining two containing rotary converters, which were built by the same firms that supplied the rectifiers. A view of the Upney sub-station equipped with G.E.C. 630-volt rectifiers is given in our Supplement.

As regards the Underground Railways, the first section of the Cockfosters extension of the Piccadilly line, consisting of 4½ miles of double track from Finsbury Park to Arnos Grove, with intermediate stations at Manor House, Turnpike Lane, Wood Green, and Bounds Green, was opened on September 19th. From Finsbury Park to a point north of Bounds Green Station, where the line emerges into the open, there are twin tunnels: Manor House, Turnpike Lane, Wood Green, and Bounds Green being deep level stations with escalators connecting the booking hall with the platforms. The second and final sections of this extension to Enfield West and Cockfosters respectively will be completed shortly. The West London extension of the Piccadilly line involved the construction and equipment of two additional tracks alongside the District Railway from Hammersmith to Northfields, a distance of 4½ miles, and the section from Hammersmith to Acton Town, which enables Piccadilly trains to run through to South Harrow, was opened on July 4th. During the present month the scheme will be completed by the running of Piccadilly trains to Hounslow, and the two new tracks from Acton Town to Northfields will be brought into use at the same time. Power for the western extension is being taken from the Lot's-road station, but eventually the lines west of Acton Town will receive current from the Neasden station of the Metropolitan Railway, which, like the Lot's-road station, supplies 33⅓-cycle current. For the Cockfosters extension, however, 50-cycle current is being supplied from the North Metropolitan Electric Supply Company's system. The new sub-stations on both extensions are equipped with 1500-kW mercury arc rectifiers designed for a D.C. pressure of 630 volts, those for Cockfosters extension being B.T.H. rectifiers and those for the Piccadilly western extension General Electric.

The progress which rectifiers made on electric traction systems during the year was very marked, and there is every indication that they will be very widely used in the future. Two other B.T.H. traction rectifiers that were completed during 1932 were for the Newport-Shilden mineral line, which was electrified at 1500 volts in 1914, when series-connected B.T.H. rotaries were employed. But as it has been necessary to change the supply from 40 to 50 cycles, it was decided to replace the rotaries by two 1500-volt rectifiers, one rated at 1200 kW and the other at 800 kW. Glass bulb rectifiers made by the Hewittic Electric Company are being installed in sub-stations on the Liverpool-Southport and Manchester-Bury lines of the London, Midland and Scottish Railway.

Arrangements were made by the Metropolitan Railway Company to increase the length of a number of its trains from seven to eight cars. Two additional lines between Wembley Park and Harrow were opened, and a new branch line consisting of 4 miles of double track were completed between Wembley Park and Stanmore. The number of high-power motor coaches working on the system was also increased considerably. The augmented demands for current called for corresponding extensions to the generating plant at the Neasden power station, and these have been met by the installation of four new boilers and associated equipment, such as coal handling and ash disposal plant, &c., and a new generating set. During these extensions the steam conditions were raised from 180 lb. per square inch and 550 deg. Fah. to 265 lb. per square inch and 750 deg. Fah. Prior to the extensions only a portion of the plant was capable of working under the latter conditions, but the whole of the low-pressure plant has now been dispensed with. Two new rotary converter sub-stations for the Stanmore line were equipped throughout by the General Electric Company, which also supplied plant for increasing the capacity of existing sub-stations.

Coming to the traction orders which the electrical firms have in hand or have recently completed, the English Electric Company is building forty-two motor coaches and twenty-one trailer coaches for the Danish State Railways; seven additional articulated locomotives for the South Indian Railway; and two additional bogie locomotives for the Bermuda Railway, to the order of the Drewry Car Company, Ltd. At the company's Preston works equipments and bodies for trolley omnibuses and bodies for petrol vehicles were built for various companies and corporations. Important contracts for tramway material for this country and abroad are also being dealt with, and steps have been taken to meet demands for oil-electric equipments.

Three B.T.H. oil-electric locomotives were delivered to the Dagenham works of the Ford Motor Company, and two battery train units to the Great Southern Railway of Ireland, on which they are now providing a regular service between Dublin, Bray, and Greystones. Interesting improvements in connection with trolley omnibuses, chiefly with regard to regenerative

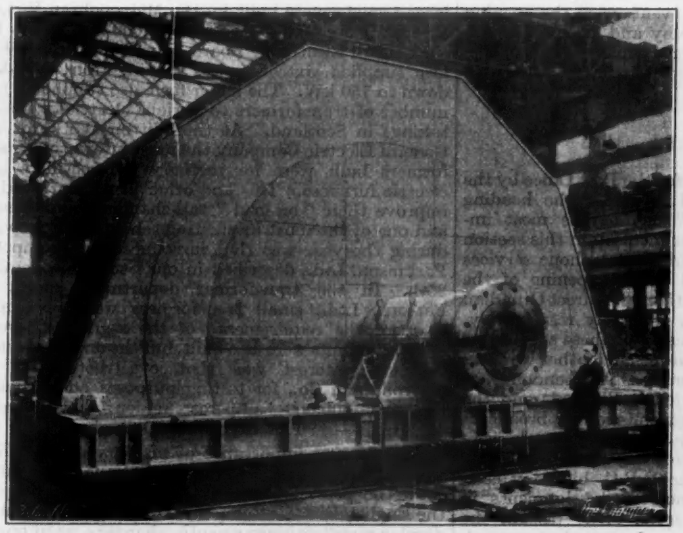


FIG. 5—7,500 H.P. SYNCHRONOUS MOTOR

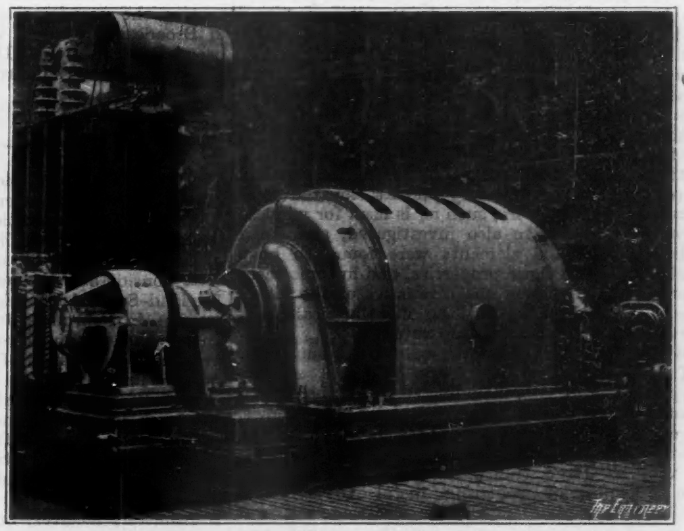


FIG. 6—20,000-kVA SYNCHRONOUS CONDENSER

control, were made at the B.T.H. works, but limitations of space will not allow us to consider them in the present article. Regenerative control for tramcars received the attention of the Metropolitan-Vickers traction engineers, and sample equipments were placed in service in Manchester and Glasgow. One of the most interesting contracts which this company has in hand is that for thirty-six 50-cycle Kando single-phase locomotives—Fig. 4—four of which were placed in service during the past twelve months.

Research.

Despite the bad times, the activities of the British Electrical and Allied Industries Research Association were fully maintained, and many important reports relating to the Association's work were issued. A leading part was taken in the work essential to improving the efficiency of steam generating plant, such as the study of the properties of steam at high temperatures and pressures, and of the creep of metals. Through the Association all interests co-operated in dealing with problems relating to overhead lines, including foundations, wind pressure, vibration, earthing, and surge problems. That of predicting interference between transmission and communication systems may now be considered to have been solved, for the results of investigations are said to have been verified experimentally on an adequate scale. As the heating of deeply buried cables and those crowded together is assuming increasing importance, methods of calculating the heating were developed. Further improvements were made in electric circuit breakers, with a view to securing increased efficiency and reliability. A critical *résumé* of available information relating to the breakdown of dielectrics was compiled, and is available to all workers in this important field. Data for the standardisation of several additional materials, including enamelled wire possessing special properties, were supplied to the British Standards Association. Increased attention was also paid to the commercial and laboratory problems associated with radio engineering.

Perhaps the principal research work carried out by the General Electric Company was that relating to discharge tubes for lighting purposes, as described by Mr. C. C. Patterson before the Illuminating Engineering Society on November 8th. Mercury arc rectifiers and new industrial applications of photo-electric cells also claimed the attention of the company's research engineers. Considerable progress was made in the development of E.H.T. valves for the rectification of A.C. at 120,000 volts and upwards, and in the design and application of the gas-filled relay. Small relays of this type are said to be finding numerous applications, whilst larger relays with a power-handing capacity about 100 times greater than that of the small units are being evolved. Further progress was made in the development of photo-electric photometers. An instrument of this type, which indicates the efficiency of the lamp under test on a scale calibrated directly in lumens per watt has been in continuous use in the Osram Lamp Factory at Wembley for the last six months, whilst another instrument of the same kind, which incorporates the latest type of amplifiers and which will measure the lumens of 15–150-watt lamps with a high degree of accuracy, is at present being constructed. Extensive experimental work is now being carried out with a view to simplifying the photometry of gas discharge tubes. The mechanical properties, both at ordinary and at elevated temperatures of nickel wire, such as is used for wireless valve filaments, were also investigated, and small additions of added elements were found to have marked effect on those properties, and in some cases improved the emission characteristics of the nickel wire. Other branches of the metallurgical work related to electric heating apparatus.

Work of a varied character was carried out in the B.T.H. engineering laboratory. Several special-purpose wireless sets, including some for the experimental reception of sound and television programmes, were designed. Various special resins, new moulding powders, and insulating materials were produced, as well as large transparent sheets of glyptal. The question of soldering metal to porcelain was investigated. The Clinker electric clock was improved and made ready for the market, and its driving device was incorporated in an experimental flashing signal device for warning traffic at cross roads, &c. An electric stethoscope, developed for medical use, is said to be much more sensitive than the non-electrical type of instrument. To this short account of B.T.H. research work much might be added. Apart from the activities in the laboratory, interesting development work was carried out in the shops, in which there is now a special high power rectifier testing equipment for obtaining accurate and complete design data. Moreover, in view of the importance of railway electrification at pressures in the neighbourhood of 1500 volts, a 1500-volt rectifier, with an output which exceeds anything likely to be required for some time to come, and which is said to exceed by a large margin that of any other British-made rectifier, was built.

Wireless Communications.

A new Marconi beam station opened at Salisbury, South Rhodesia, for service with England, was one of the important additions to the wireless communications system of the British Empire, a special feature of the installation being the concentration of the transmitting and receiving equipment on the same site. The Indian beam stations were enlarged and provided with Marconi telephone equipment for the India–England telephone service, operated in this country by the General Post Office, whilst telegraph equipment was also installed for communication with Japan. The South African beam stations were equipped with apparatus for telephone communication with the Post Office stations in England, and during the year these services were inaugurated. The requirements of aeroplane equipment for wireless working along the African air route, on which, owing to frequent and violent electrical storms, extremely difficult conditions are encountered, gave rise to special investigations. Early in the year Marconi engineers spent six months flying along the route in various types of aircraft, and, as the result of observations made, a new form of aircraft equipment was produced, capable of operating satisfactorily on short and medium wave lengths at all times. Mainly for the benefit of coasting vessels, trawlers and other small craft, which are not normally required to carry wireless apparatus under International regulations, a maritime wireless service, using Marconi apparatus, was put into operation by the G.P.O.

Outside the British Empire, one of the most important wireless services put into operation was that between Belgium and the Belgian Congo, for which combined telephone and telegraph transmitting and receiving equipment of the Marconi beam type was installed near Brussels and near Leopoldville in the Belgian Congo, the service being extended to this country by the G.P.O. With the completion of the wireless network linking the principal Arabian cities, in which there are eleven Marconi fixed stations and four mobile stations, Arabian wireless communications made a great advance. One of the outstanding events of the year was the demonstration by Marchese Marconi in Italy of the possibility of using waves of less than 1 m. over distances far in excess of those considered theoretically practicable. Experiments showed that communication could be established over a distance of 168 miles and demonstrated that these very short waves can overcome the supposed obstacle presented by the curvature of the earth. At the British Association meeting, held at York in August, the Marconi Company also demonstrated the results of its engineers' work on television. Owing to the growing number and increased power of transmitting stations, attention was paid during the year to refined frequency control in the case of transmitters and greater selectivity in the case of receivers. A new type of short-wave beam aerial array, known as the horizontal uniform aerial, which is cheap to erect and which for a given concentration of radiation occupies less space than the standard array in Marconi beam stations, is said to have given excellent results at the Somerton station. As regards broadcasting, the most important events were the opening of Broadcasting House in May and of the Empire broadcasting station at Daventry in December. The West African aerial array for the latter is shown in Fig. 2.

Post Office Wireless Work.

Apart from the work done for the Post Office by the Marconi Company, referred to under the heading "Wireless Communication," one of the most important matters that calls for mention in this section of our review is that the wireless telephone services were considerably extended by the opening of the England–South Africa, Egyptian, and direct Canadian services in February, June, and July respectively, and by the subsequent extension of these services to practically the whole of Europe and other wireless systems linked with this country. The London–New York service was also extended to Bermuda and the Sandwich Isles. For the transmission of broadcast programmes, the Post Office wireless channels were extensively used, notably for the Christmas Day Empire programme, and the B.B.C. birthday celebrations. By the application of developments in transmitter, receiver, and aerial array design, the wireless telephone services was continuously improved. An additional short-wave transmitter, receiver, and directive arrays were added to the long-distance ship and shore services, *viâ* Portishead. The Land's End station was reconstructed and equipped with modern valve transmitters in place of the spark sets, and direction-finding equipment was transferred to this station from the Lizard station, which was shut down. At the Rugby wireless station a 500-kW "sealed off" valve, developed by the General Electric Company, has taken the place of thirty ten-kilowatt valves, used as the output stage of the long-wave transmitter. The use of continuously evacuated valves was extended to short-wave work, and two 30-kW valves of the type are in continuous use at Rugby. Development work on ultra short-waves culminated in the operation by the Post Office of an experimental 5 m. wireless link across the Severn estuary between Weston and Cardiff. This new link, covering a distance of 12 miles, replaces 45 miles of circuitous land line, for which it forms a simple and efficient substitute.

Miscellaneous.

Even in a review of electrical progress in such a slack year as 1932, it is impossible to do justice to manufacturing activities without making the story unduly long and in all probability very monotonous. High-capacity switchgear was again in demand and, as the "grid" is nearing completion, increased attention was paid to switchgear for various secondary distribution schemes. The British Thomson-Houston Company, the Metropolitan-Vickers Electrical Company, the English Electric Company, and the General Electric Company all seem to have turned out a fair amount of switching equipment, and there were interesting developments in design, as, for example, in the case of the 66-kV Metrovick switchgear installed in the Battersea power station. Similarly certain improvements were made in the design of protective gear. As A.C. is rapidly replacing D.C. for power and industrial purposes, it is not surprising to learn that manufacturers devoted special attention to A.C. motors, particularly those required to give speed variation and power factor correction. Speed ranges of 12 to 1 or more on A.C. commutator motors made by the British Thomson-Houston Company, are now usual, whereas a few years ago a range of 5 to 1 was the limit. One of the most notable large synchronous motors built by this firm during the year was the machine shown in Fig. 5, which is rated at 7500 H.P. at 93·8 r.p.m., and is capable of taking peak loads of 18,750 H.P. Ordered on August 19th through Associated Electric Industries (India), Ltd., for the Tata Iron and Steel Company, the machine was built in record time, for it was dispatched, with its control equipment, on October 22nd. Another important and highly interesting job was the manufacture by the Metropolitan-Vickers Electrical Company of three 20,000-kVA synchronous condensers (Fig. 6), for the Victoria Falls and Transvaal Power Company. To meet the requirements of the "Grid" scheme, this firm built motors aggregating 15,000 H.P. to replace non-standard frequency motors. Turning from these large machines to the other extreme, the General Electric Company introduced a new fractional horse-power motor, known as the "Clean-start," which is a single-phase squirrel-cage motor, with improved starting characteristics.

The largest transformers built during the year are said to be the two 93,750-kVA units for Barking, but there were others with large outputs, such as the 80,000-kVA units, built by Ferranti, Ltd., for Battersea. The output of the British Thomson-Houston Company's transformer department surpassed all previous records. Among the special transformers built at Rugby was a rotary converter unit for use initially as a 2/6 phase unit, and subsequently as a 3/6 phase unit. Another special transformer built at these works was for a rotary converter operating A.C. to D.C. or D.C. to A.C. with a very wide voltage range obtained by a combination of "off load" and "on load" tap-changing gear, giving a total voltage variation of 33 per cent. Among the large transformers built by the Metropolitan-Vickers Electrical Company were four 30,000-kVA units for the Central Electricity Board, to which Bruce Peebles also supplied sixteen units, varying from 3000-kW down to 750 kW. The latter firm also supplied a fair number of transformers to various electricity undertakings in Scotland. At the Witton Works of the General Electric Company the most interesting transformers built were for mercury arc rectifiers and electric furnaces. This and other firms continued to improve their "on-load" tap-changing equipments, and one of the most interesting schemes put forward during the year was that introduced by Crompton-Parkinson, Ltd., described in our issue of November 25th. In the transformer department of C. A. Parsons, Ltd., small transformers were developed to meet the requirements of the "grid." Several 6000-kVA units were also built, but the unit of greatest technical interest was that constructed for A. Reyrolle and Co., for testing purposes and designed to give 600,000 ampères under short circuit conditions—see THE ENGINEER, December 30th.

The growing importance of mercury arc rectifiers was exemplified by the demonstrations designed to show the possibilities of grid-controlled rectifiers at the English Electric Company's works last November. Similar rectifiers were recently shown to us in operation at the works of the Hewittic Electric Company, which claims to have supplied the first rectifiers of this type for battery-charging with variable voltage. The demand at the moment, however, is for ordinary rectifiers without grid control, and besides those mentioned under the heading of "Electric Traction," Bruce Peebles supplied a 1000-kW metal-cased rectifier to the Yorkshire Copper Works, Leeds, and glass-bulb rectifiers to other customers. Motor converters, which at one time were made by this firm alone, are still being called for, and two 1000-kW Peebles machines were among the converting equipment made during the year. Four notable motor converters are at present under construction at the British Thomson-Houston Company's works. Two are rated at 2000 kW at 600 r.p.m., and two at 1500 at 750 r.p.m. A fair number of rotary converters was also built at Rugby for service in this country and abroad.

Water-wheel alternators and frequency changers were among the 1932 products of this and other firms,

and it would be possible, if space permitted, to mention many other important industrial jobs. The Metropolitan-Vickers Electrical Company states, for instance, that a considerable number of rolling mill drives were completed or are under construction for blooming mills, tube mills, bar mills, plate mills, &c., and it also refers, among other industrial items, to several large winding equipments for coal and other mines. The English Electric Company also reports that orders for large rolling mill motors were received, but, having described some of the company's principal activities as recently as last November, it is scarcely necessary to deal with the work again.

Hungarian Railways Electrification.

NO. I.

IN the main line electrification of the Hungarian State Railways an important stage was reached on September 12th, 1932, when the first two 2500 H.P. locomotives to be completed, out of a total of thirty-six ordered in April, 1931, were put into regular passenger train service. Two other locomotives of similar power, but designed for goods trains, have also been delivered and put into operation. The Hungarian railway electrification scheme is of general interest, because the Kando system adopted has entirely new features, the trolley wire being fed with 16,000-volt, single-phase power tapped from a State three-phase transmission line, which supplies energy for industrial as well as traction purposes at the standard frequency of 50 cycles. Many of the following details of operation and control will be of particular interest to British readers, to whom the system will be novel in many respects, and it is gratifying that so much of the work has been entrusted to a British manufacturer.

The section of the main line now being electrified extends from Budapest to Hegyeshalom, a distance of 120 miles, and of this distance some 60 miles of line from Budapest to Komarom are already completely equipped. The line is double track throughout. From Budapest it rises generally at a ruling gradient of 1/150 for 25 miles, then falls for 25 miles at the same gradient, and afterwards is practically level to Hegyeshalom. In the hilly section curves having a radius of 1310ft. occur at frequent intervals. Although the traffic is not dense according to British standards, many heavy international trains pass over the line. Electric power for the railway is obtained from a power station which has been erected at Banhida, designed to supply energy not only to the railway, but also a greater part of the power required by the city of Budapest and to the Western Hungarian industrial district in the neighbourhood of Gyop and of Hegyeshalom. The station is situated on the western edge of the Tata coal region, which has some 15 million tons of coal, containing from 35 to 50 per cent. ash, and having a calorific value between 4650 and 7920 B.Th.U. per pound.

With the treaty of Trianon, the size of the country was considerably reduced, and it lost nearly all its sources of natural gas, 94 per cent. of its water power, and 60 per cent. of its coal, with the result that economy in coal consumption is now a matter of vital importance. The collieries supply only a small quantity of high quality coal, all of which is needed for domestic firing. This leaves only the poor and medium quality coal (quite unsuitable for burning in steam locomotives) available for use in the power station, in which it is burned by forcing preheated air into the boiler furnaces. The economical working of the power station is greatly assisted by traction and industrial loads being combined to maintain a high load factor. Three-phase current at 50 cycles is generated, and is distributed at 110,000 volts by a duplicate transmission line which follows, generally, the railway route, and at four sub-stations energy from the transmission line is transformed to 16,000 volt single-phase for connection to the overhead trolley wire.

The Kando system has been developed as part of the effort to utilise to the best advantage the internal fuel resources of the country, and having in mind the traffic requirements to be dealt with.

Fifty-cycle, 16,000-volt, single-phase current is supplied to each locomotive through an oil circuit-breaker, and passes to a phase converter, which transforms it to polyphase power at about 1000 volts. From the phase converter the power is taken through switchgear to a 2500 H.P. polyphase induction motor, from which the power is transmitted to the wheels by side rods. The motor is designed so that by means of pole-changing connections four economical speeds are obtained. Noteworthy features are that the phase converter is arranged to work at practically unity power factor, the voltage applied to the main motor being varied to ensure a high efficiency at all loads, and regenerative braking occurs automatically. A disadvantage of the system which is common to all A.C. traction systems, is the heavy expense incurred in consequence of the necessary replacement of all overhead telephone and telegraph wires running alongside the railway track by underground cables. On the other hand, the use of A.C. makes it possible for the energy to be taken from the 110,000-volt transmission line to the overhead trolley wire through simple static transformers. This feature simplifies the sub-stations, while the use of 16,000-volt pressure on the trolley wire makes possible the employment of very few sub-stations, and of light trolley wire conductors with light supporting structures. For this particular scheme there are only four sub-stations, the entire equipment for which was supplied by the Metropolitan-Vickers Electrical Company. Two sub-stations at Banhida and Torbagy respectively are now in service.

Each sub-station contains equipment for two 110,000-volt incoming feeders, two 4000 kVA, single-

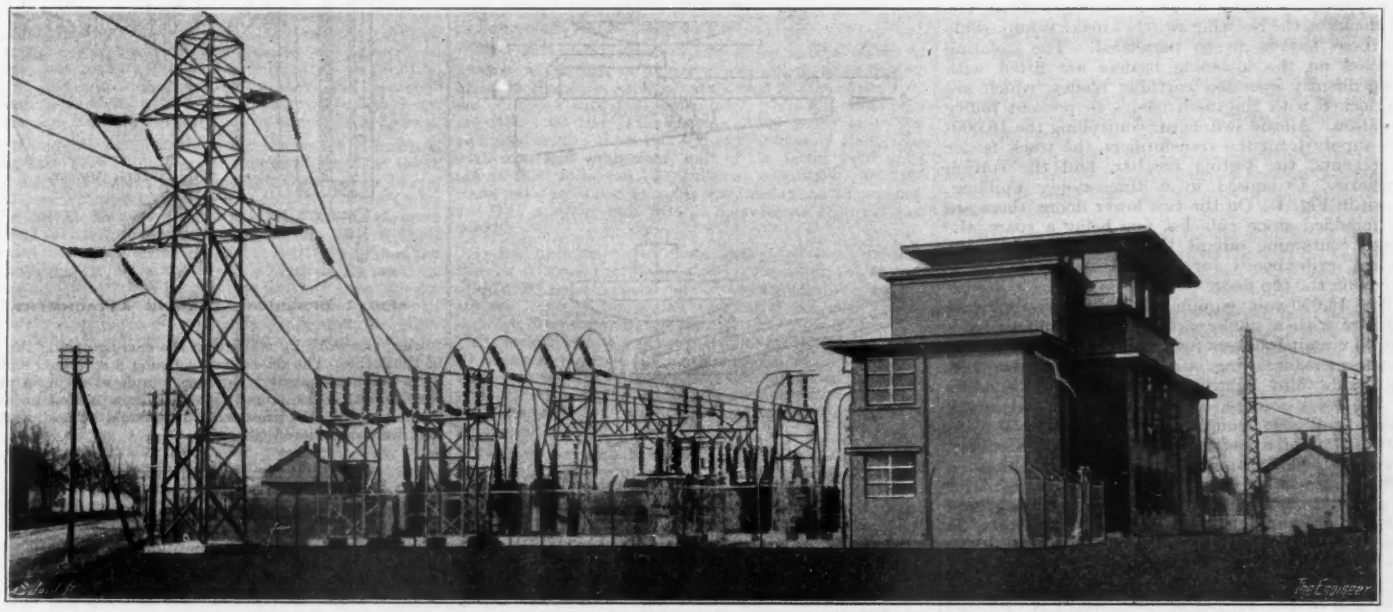
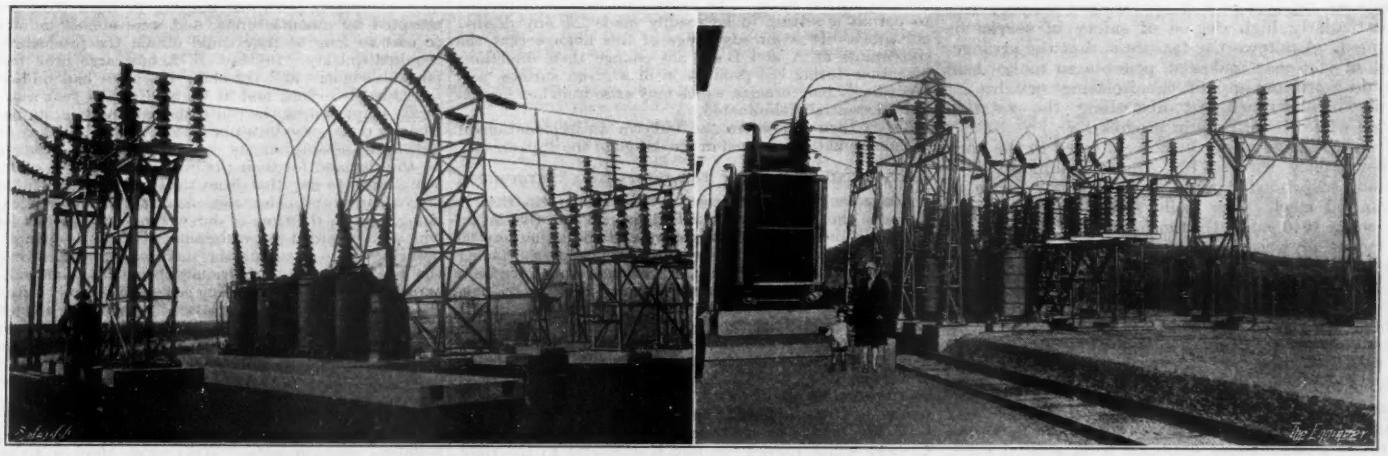


FIG. 1—GENERAL VIEW OF TORBAGY SUB-STATION



FIGS. 2 AND 3—CIRCUIT BREAKERS AND TRANSFORMERS AT TORBAGY SUB-STATION

phase 110,000/16,000-volt transformers, and two track feeder equipments, together with apparatus to supply the station auxiliaries and a testing bus-bar. Space is available for a third transformer. The incoming connections are taken from one phase of each of the duplicate 110,000-volt transmission lines, and led through isolating switches and oil circuit-breakers to two separate sets of 110 kV sub-station bus-bars, from which connections pass through isolating switches and oil circuit-breakers to the two 4000 kVA transformers, all this apparatus being installed out of doors as illustrated in Figs. 1, 2 and 3. The transformers are of the oil-insulated, self-cooled type, and have tappings for voltage adjustments of plus or minus 2·5, 5 and 7·5 per cent.

The 110 kV oil circuit-breakers are double-pole Metrovick units, with motor-operated mechanism for closing and tripping from the control room. Each pole is contained in a separate tank, and the terminals are brought out through condenser-type bushing fitted with current transformers. The contacts are of the wedge and finger type, and are fitted with corona shields. Each circuit-breaker has a rupturing capacity of 400,000 kVA. The 110 kV isolating switches are Metrovick double-pole, double-break switches with jaw contacts fitted with shrouds as a protection against the weather and corona, and they are arranged for mechanical operation through rods from the ground. The sub-station can be supplied by either of the incoming feeders, but interlocks on the isolating switches make it impossible for these feeders to be paralleled. The isolating switches on the incoming feeders are fitted with independently operated earthing blades, which are interlocked with the main blades to prevent faulty operation. All the switchgear controlling the 16,000-volt supply from the transformers, the track feeder equipments, the testing bus-bar, and the station auxiliaries, is housed in a three-storey building, shown in Fig. 1. On the two lower floors, there are ten moulded stone cubicles, one being a spare, the others containing circuit breakers, &c., while the control switchboard for the entire sub-station is placed on the top floor.

The 16,000-volt equipment comprises duplicate bus-bars with a single earth bar, isolating switches and oil circuit-breakers for the connections from the transformers, isolating switches, oil circuit-breakers and oxide film lightning arresters with isolators for the track feeders, isolating switches and an oil circuit-breaker for coupling the bus-bars, a 50 kVA, 16,000/275-volt transformer for the station auxiliary services, a 50 kVA transformer for use in combination with an auto-transformer, and an induction regulator to give 0–20,000 volts for trolley line testing, and capable of supplying current at 270 volts in case of failure of the auxiliary transformer. The oil circuit-breakers are Metrovick single-pole breakers, the remaining pole being earthed, and with the exception of the bus-bar coupler, which is operated mechanically at the cubicle, all the breakers are motor-operated.

In general, the 22,000-volt knife isolating switches are mechanically operated from the control board, which is composed of white marble panels carrying the necessary instruments and switchgear for the control of the entire sub-station.

For the supply of current for D.C. motors operating the oil circuit-breakers a 244-volt, 122-cell battery and a motor generator set have been installed, together with a switch which automatically throws the station lighting on to the battery in the event of failure of the auxiliary transformer. In general, the sub-stations are designed on simple lines, and by the double bus-bar system and separate test bar provided, a particularly high degree of safety of service is obtained. A noteworthy feature is that the arrangement of the gear makes it possible to make dead and do work on any of the isolating switches or circuit breakers without disturbing the traction service while the work is in progress.

From the sub-station the current is led to the hard copper trolley wire of 100 square millimetre cross section, suspended from a single catenary wire of galvanised steel. The trolley wire is divided into sections of 1640 yards, the tension being kept constant by means of weights at both ends of the section. The standard distance between masts is 82 yards and the overhead construction is exceedingly simple and light. At stations where several tracks are involved, the suspension is from a catenary wire which runs at right angles to the track, as many as ten trolley wires being supported from a single cross span. Switching arrangements are provided at every important station by which any section of track may be made dead. These switches are of the overhead air break isolator type, operated from ground level, and are usually in groups of eight.

(To be continued.)

WHAT is claimed to be the largest programme of reinforcements on bridge structures ever attempted in South America, is now being undertaken by the Buenos Aires Western Railway in the strengthening of forty-four culvert bridges by arc welding. According to *Electric Welding*, the complete renovation of each would have cost some 1300·00 dollars, whereas strengthening by arc welding works out at 826·42 dollars per bridge, with the further advantage that no traffic interruptions are caused.

Turning Spherical Surfaces.

IN our issue of November 11th last, we made brief reference to an ingenious method of turning spherical surfaces of large radii with a compact equipment devised by the United States Bureau of Standards, and are now able to give some more details and illustrations, taken from Research Paper No. 467 of that Bureau.

In turning, for example, the grinding disc for a large astronomical lens, the curvature may be so slight that to guide the tool by means of a radius rod would be most cumbrous, on account of the length of that rod. With the device under review surfaces of almost, but not absolutely, perfect spherical shape, can be produced within the compass of the lathe bed, and adjustments can be made to work to different amounts of curvature. The attachment is described in the bulletin first, in principle, with the aid of the diagram Fig. 1, and then as it has been manufactured by the Mann Instrument Company, of Cambridge, Mass., in Fig. 2.

The spherical surface to be produced is turned on a lathe by a single-tooth tool mounted in a special tool holder which is guided to generate the desired surface by a simple linkage system. A plan view of the fundamental parts is shown diagrammatically in Fig.1. The line K N

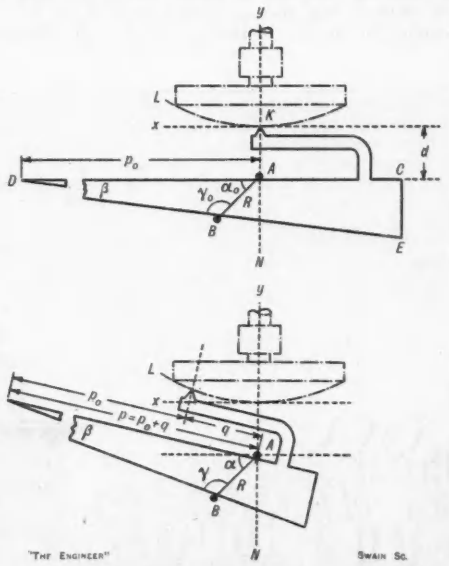


FIG 1—PRINCIPLE OF OPERATION

is the axis of the lathe spindle, and the arc K L is a meridian section of the curved surface, which is turned by the cutting tool indicated at K. At A and B are two pins which are fixed to the lathe carriage. The triangle C D E on which the cutting tool is rigidly mounted, is pushed across the lathe by a cross feed, and, as it advances, the two sides remain in contact with the pins A and B, thereby causing the triangle to rotate in such a manner that the cutting tool generates the arc K L. When the lathe spindle is revolving, therefore, a surface of revolution with the arc K L as a meridian section is produced.

Under the guidance of this linkage, the tool generates an arc which is not truly circular, but the approximation is satisfactory over the entire range of curvatures for which the use of a radius bar is unsatisfactory. Therefore, the two methods supplement each other, and, together, provide for the production of any curvature. The amount of curvature is determined by the magnitude of the angle between lines D E and D C and by the length A B. It is convenient to hold A B constant and provide means for varying the angle. The instrument may be calibrated to permit a setting to be readily made for any desired curvature. It is an advantage of this linkage that the constraints at A and B do not change their directions of action during the production of a given surface, and accordingly inaccuracies, which may arise from lost motion are substantially eliminated.

There then follows in the bulletin an explanation of the mathematics involved in the design of the appliance.

MECHANICAL DETAILS OF THE COMPLETED INSTRUMENT.

The attachment has been built in such form that it replaces the usual compound slide rest on the lathe. No other alterations are necessary and the lathe may be used interchangeably for ordinary turning or the facing of spherical surfaces. In Fig. 1 the constraints have been represented as pins against which the sides of the triangle bear. In the mechanical realisation of this linkage the pins are necessarily replaced by pivoted slides of sufficient strength to oppose the forces on the cutting tool. The detailed design, as completed at the Bureau of Standards, is shown in Fig. 2. The tool, indicated at L, is carried on a cross slide pivoted at A. The pivot at A corresponds to the similarly lettered constraint in Fig. 1, and the line C D corresponds to the line C D of the triangle. The member which carries the tool is extended to the right of the slide and carries a sector F G B, pivoted at B. This sector is rotated about B and may be set in any desired position by means of the worm, which is rotated by the handle at I. The angular setting of the sector can be read by an arc graduated in degrees and by a graduated drum which is mounted on the shaft of the worm. On the lower surface of the sector there is a male dovetailed member indicated by the dotted lines parallel to the line D E of Fig. 1. This dovetailed member corresponds to the side D E of the triangle of Fig. 1 and it can be set in the required position for any desired radius of curvature by rotating the sector. The arc, carried by the sector, is graduated to permit the value of β to be read directly. In Fig. 2 the setting illustrated corresponds to $\beta=0$, C D and D E are parallel, and the instrument will produce a plane surface. The dovetailed member which has been mentioned slides in a short dovetailed slide pivoted in the base at B. The small section indicates the details of this arrangement. The pivots A and B, corresponding to the constraints A and B respectively, of Fig. 1, are carried by the base of the attachment and remain invariant in position with respect to each other. It will be noted that the pivot about which the sector rotates is directly over the pivot at B when the main slide is at right angles to the axis of the lathe and the point of the tool is on the axis of the lathe. Consequently, when in this position, the sector can be rotated through any desired angle without causing any rotation of the line D C about A.

The setting for any desired curvature is made by turning the handle I, after which the sector is clamped in position by the nut at K. The cut is then made in the usual manner by turning the handle at I. To advance the tool for a second cut, the entire attachment is advanced

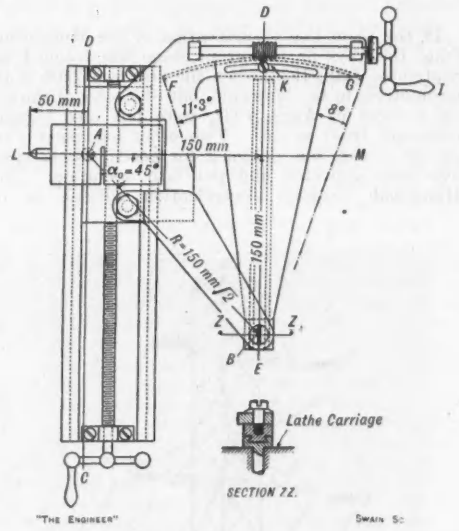


FIG. 2—SPHERICAL TURNING ATTACHMENT

toward the work by traversing the carriage along the bed of the lathe. The operation of facing a spherical surface with this attachment is quite as simple as facing a plane surface with a compound slide rest, except that no automatic cross feed is provided. This could be easily added if it were considered essential.

SIXTY YEARS AGO.

THE story of the industrial position and prospects which we had to tell in our issue of January 3rd, 1873, was, in the main, the exact reverse of that which we record to-day. From the point of view of trade and business activity, the year 1872 had been a remarkable one, and there was every sign that 1873 would be equally remarkable. Why business had been, and continued to be, so good we could not exactly state. It might be that new districts were being opened up and required large supplies from our workshops, or it might be that the stoppage of production on the Continent of Europe which had accompanied the Franco-Prussian War had still to be made good. We left it at that and, parenthetically, we may remark that we did not apparently seem to be greatly interested in discovering why business was good. When trade is bad we are all anxious to discover the reason, but when trade is good we are apt to accept it as a gift from the gods without inquiring too closely into the cause of our prosperity. There was no doubt about the prosperous state of British industry in 1872. Purchasers had actually been competing with one another to have their orders accepted by manufacturers, and were almost indifferent to cost so long as they could obtain the products they required quickly. In May, 1872, one large firm making portable engines and thrashing machines had refused to take further orders, and at the end of the year was still busily employed on the contracts remaining on its books. Nor, we noted, was its situation exceptional. Many other industrial establishments were similarly overwhelmed by the demand for their products. It is a fact of much significance to-day that from the start of the year prices of coal, iron and other raw materials had been steadily rising, and at the time of our writing had reached levels which we regarded as exorbitant. It did not, apparently, occur to us to associate the increase of prosperity with the rise in the cost of primary products. Instead, we expressed concern at the rising costs and severely criticised the action of the "working classes," who, taking advantage of the situation, had extorted from the employers increased wages and shorter hours. It was essential, we argued, that by the devising of new processes and machines capital should strive to make itself ever more and more independent of labour. Such was our advice, but it was clearly not being followed. The year, we said, had been completely barren as regarded new inventions, and technical developments. With more than a tinge of regret we noted that engineers and manufacturers in general had made no effort to improve either their products or their methods of production, but had been content to follow established practice. That fact was, we had to confess, understandable and, perhaps, excusable. When the whole produce of a factory or workshop could be disposed of immediately it was finished, or even before, there was no incentive to improve the product or its method of manufacture, and even if there were such incentive people were far too busy to spend time on the development of inventions. Industrial prosperity, therefore, as we interpreted the situation in 1873, brought in its train unrest among the workers and a stagnation of the technical developments and progress whereby the effects of that unrest might best be countered.

Railway and Road Matters.

DURING the four summer months of June-September last, the Southern Railway carried 138,021 passengers to the Channel Islands, as compared with 125,762 in 1931, and 121,782 in 1930. In 1922 the number was 74,010.

THE railway companies of the United States agreed on December 21st to withdraw their proposals for the 10 per cent. reduction in their men's pay to be increased to 20 per cent., and the men on their side agreed to accept the present conditions for another nine months.

WE understand that the four independent members of the National Wages Board, recognising the importance of their views on the subject of the proposed reduction in the railwaymen's pay, have accelerated the day for their first conference, and met on Friday last instead of to-day. It is expected that there will be a meeting of the full Board on Tuesday next, January 10th.

THE *Southern Railway Magazine* for December, speaking of the proposed train ferry of the Southern Railway Company between Dover and, probably, Dunkirk, says that there will be many difficulties of a technical nature to be overcome. The main problem is of tide variation, which, at Dover, rises and falls over 25ft. It is probable that some sort of lock will be established so that the ferry-boat can be kept at rail level at all times.

As far as can be traced, some 350 oil-engine locomotives in sizes above 150 H.P. have been constructed since 1913, the total engine horse-power being in the neighbourhood of 160,000. Below 150 H.P., there are in existence something like 3000 locomotives, or loco-tractors, as they are styled. Two-thirds of this number are at work in Europe, but many of them are only of 20 to 50 H.P. Finally, just over 200 oil-engined rail-cars have been constructed; about 125, with a total horse-power of 22,000, are in service in Europe, but the number is increasing rapidly.

RAILWAYMEN of all degrees will welcome the mention in the New Year Honours of the name of Mr. J. P. Scott Main, assistant to the Chief Inspecting Officer of Railways, Ministry of Transport, who is made an officer of the Order of the British Empire (Civil Division). Mr. Main, after practical locomotive experience on the Manchester, Sheffield and Lincolnshire Railway and in Australia, joined the Railway Department of the Board of Trade as an Assistant Inspecting Officer in 1901, under the Railway Employment (Prevention of Accidents) Act, 1900. On the creation of the Safety Appliances Committee in April, 1906, Mr. Main was made the Secretary, and he is now a member and the Secretary.

IN the *Railway Newsletter* for November last appeared a table which was intended to show what becomes of every £1 of the revenue received by the four grouped companies during the years 1929, 1930 and 1931, as compared with 1913. These are presented under five headings, three of which give rather remarkable results. Whilst we were quite prepared to find that 11s. 2d. out of every £1 now goes in wages and salaries, as against 7s. 3d. in 1913, and that the amount available for interest and dividends is 3s. 8d. instead of 7s., we note that under the other three headings of (1) material; (2) rates, taxes and national insurance, and (3) sundry items, the amounts now being paid out are less than in 1913. Materials, for instance, take 3s. 10d., instead of 4s. 2d. in 1913; rates, taxes, &c., require 10d., which is the same, whilst sundry items need 6d. instead of 9d.

IN the matter of safety in railway travel, the years 1901 and 1908 stand out pre-eminent, as therein there was no accident to a passenger train in which passengers were killed. The years 1909, 1917, 1925, 1929 and 1930 came as next best, as each had only one fatal accident. Moreover, in 1909, 1925 and 1930 only one passenger was killed. Next to the five years just named as having had one accident, came 1914, 1918, 1920 and 1923 with only two. The record for the year that has just closed is one of the better kind, in that there was only one fatal accident—the derailment of June 17th at Great Bridgeford, in which three passengers lost their lives. Additionally, the reports so far issued of the accidents of last year include two in which trainmen were killed; those were a guard in the collision of April 11th at Victoria-Exchange Station, Manchester, and the driver in the derailment of June 12th at Wardleworth. The report of Lieut.-Colonel Mount on the Great Bridgeford derailment has been delayed owing to the driver's ill-health as a consequence of the accident.

PARAGRAPHS have appeared in the daily Press recently as to the London, Midland and Scottish Company having introduced, as from January 1st, a new rule book for the instruction and guidance of its servants. In doing this the L.M. and S. does not lead the way, as in February, 1930, the Southern Railway issued a new rule book, the preface to which said: "These rules and regulations have been agreed to generally by the companies parties to the Railway Clearing system." This work is an undertaking of a committee at the Railway Clearing House, known as the Rule Book Committee, which consists of specially qualified experts from each company who, from time to time, review and decide questions of operation, particularly in the light of the Ministry of Transport reports on railway accidents. In view of the extent to which the trains of one company, under what are known as running powers, travel over the lines of another company, uniformity in the rules was very necessary. It was, however, hard to obtain and former rule books contained a very large number of exemptions and modifications to suit working over foreign lines. That difficulty has, under grouping, been greatly reduced. As long ago as 1862 there was an R.C.H. Committee appointed to consider this question, and a standard book resulted in 1867. It was, however, accepted by only ten of the principal companies. In June, 1874, the Royal Commission on Railway Accidents was appointed, and it is significant that, in the following November, the railway general managers set up another committee to consider the matter. Their labours were successful, and a new standard rule book was approved in March, 1876, which was accepted by all the companies except a few minor ones. It contained 383 rules on 142 pages, and was the basis of the rule book of to-day, which has 212 pages, but the rules have been so standardised that they now number only 281.

Notes and Memoranda.

IT has required 2794 tons of grit, rubble, and chalk to fill a hole which was formed in the bed of the Thames, just below Tower Bridge, through the disturbing action of ships anchoring there.

THE water supply for Indian Gardens, Arizona, is pumped up from the Grand Canyon through a vertical lift of 3180ft. In order to protect the rising main against being burst by frost a thermostat is arranged to open a valve for draining the pipe.

A NOVEL method of tamping concrete placed in forms of walls and other structural units, is coming into use, states *Scientific American*. It comprises a tube within which an excentric weight is revolved in such a manner as to cause it to vibrate 5000 times per minute. This tube is inserted into the plastic concrete being placed, and the vibration aids the concrete to flow around reinforcing rods and into the narrow parts of the form-work. It is claimed that one such electric tamper will do the work of five to fifteen hand tampers.

IN connection with the important question of humidity in the timber drying, artificial silk manufacture, confectionery making, and other trades, it will be of interest to know that Negretti and Zambra have just published a set of tables of relative humidities from wet and dry bulb hygrometers, for temperatures up to 100 deg. Cent. The tables were compiled by Dr. Ezer Griffiths and Mr. J. H. Awbery, of the National Physical Laboratory, and are reproduced by permission of the Director. Similar tables in Fahrenheit will be ready shortly.

OF the 11,500 railway route miles in the world at present electrified, or under construction, according to Mr. J. M. Kennedy, approximately 6200 or, say, 55 per cent. are equipped with D.C. machinery, while the remainder are A.C. Of the D.C. systems, 1300 route miles are equipped with a third rail and approximately 5000 miles with overhead equipment, and of the latter 2200 miles are at 1500 volts and 1900 miles at 3000 volts. Of 4800 route miles equipped since the war, more than 66 per cent. are D.C. and the bulk of this operates at 1500 volts or over.

IT has been shown by investigations of the American Bureau of Mines that if moisture condenses on the surface of electric insulating material it can make a path for a small electric "leak," after which the heat of the small sparks between droplets of water slightly carbonises the surface. This track of carbon acts as a path for a still larger current, which chars more of the surface and thus makes a low-resistance path in which a heavy current generates a high temperature, with the resulting decomposition of surrounding material and production of considerable quantities of inflammable gases.

VARIOUS methods have been developed for improving the holding power of nails. These treatments include cement coating, sand blasting, and acid etching of the nail surface to produce a roughened condition, but up to the present of these treatments only cement coating has received wide commercial application. According to *Steel*, Mr. G. J. Comstock has been granted a patent covering both acid etching and sand blasting of nails and fastenings to improve their holding properties. According to Mr. Comstock, the sand blast is applied to large quantities of nails at one time, thereby minimising the cost.

"WE co-operated in a recent test of tubing for use in refrigerator coils," says the Electro Metallurgical Sales Corpn., in a letter to the *Iron Age*. "Tubes made from the following four materials were investigated:—Low-carbon steel, sherardised; low copper-molybdenum iron; 5 per cent. chromium steel, and nickel-chromium steel (S.A.E. 3120). Of the tests made, which were designed to indicate the relative resistance to corrosion in actual service, the 5 per cent. chromium steel ranked first and others in order were the nickel-chromium steel, copper-molybdenum iron, and carbon steel sherardised."

ELECTRICALLY produced ozone has not, it is suggested, been used to any material extent in Great Britain or in the British Empire for the sterilisation of water for the supply to towns and villages. In France, however, according to Mr. T. Rich in *The Electrical Review*, rapid progress has been made with the system, which is very simple. Fresh air is drawn through a high-frequency ozone generator, and then intimately mixed with the water to be purified in a special form of injector; the excess ozone is discharged by passing the water over a series of weirs. The water is then potable, the microbes having been burnt up by the ultra-active oxygen.

IN building up moulds for die casting aluminium alloys care must, says Mr. C. Vaughan, of Birmingham, be taken in selecting the materials. Molten aluminium has a solvent action on all the metallic materials that are available for mould parts. For the main sections close-grain cast iron is suitable, but semi-steel castings will give longer life, especially if a small percentage of chrome is added. Considerably more than 200,000 castings, each weighing more than 3 lb., were made from a mould having the following percentage analysis:—Silicon, 1·80; sulphur, 0·95; phosphorus, 0·13; manganese, 0·60; total carbon, 3·70; combined carbon, 0·70; chromium, 0·65; and nickel, 0·25.

WITH the increasing use of wood preservatives in extending the life of wood structures, problems are constantly being encountered, the importance of which could not be foreseen in the early days of the development of this practice. One such problem is the "bleeding" of timbers after impregnation with creosote. By "bleeding" is meant the exudation of creosote to the surface of the timber, rendering it difficult to handle, and a menace to the wearing apparel of the workmen or others coming in contact with it. In the case of telephone poles on city streets "bleeding" may be a source of considerable annoyance. The Forest Products Laboratories of Canada, Forest Service, Department of the Interior, are investigating this problem, and at present have a large number of poles under observation. These were treated under pressure by several different methods, and it is hoped to be able from these experiments to determine the treatments most effective in preventing "bleeding."

Miscellanea.

IT is proposed to set up a factory for canning turtle on the river Amazon.

IT is said that the United States oil industry pays in taxes 909,000,000 dollars a year.

A NEW port for handling iron ore is being built at Kamysh-Burun, on the sea of Azof.

AN all-metal dirigible airship is to be constructed in Russia to the designs of the inventor, Tsiulkovsky.

IT is reported in the *Daily Telegraph* that all the tramways in Paris are to be replaced by motor omnibuses.

DURING the week before Christmas there was shipped from Blyth the record amount of 122,666 tons of coal.

THE plant of the Falconbridge nickel mines, near Sudbury, Ontario, is being extended to increase the output by 30 per cent.

THE Canadian National Railway has ordered 500 all-steel gondola cars from the Eastern Car Company, of Trenton, Nova Scotia.

A REPORT on the destruction of timber by marine organisms in the Port of Sydney has been compiled with the assistance of officers of the Australian Museum.

GREAT BRITAIN has supplied 85 per cent. of New Zealand's motor car imports and 86 per cent. of the commercial vehicles during the first ten months of this year.

THE luxurious steam yacht "Rover," which was owned by the late Earl of Inchcape, has been sold to an American syndicate, and is shortly to leave Falmouth for New York.

DURING last year a new 6in. water main was laid by the Sydney Harbour Trust Commissioners between Balmain and Goat Island, to replace the old main put down thirty-five years ago.

THE first of thirty Hawker aeroplanes ordered by the Persian Government in this country is to be delivered in about two weeks' time. The order is said to be worth about £200,000.

WORK has been started on the construction of the Ville La Salle–Caughnawaga Bridge over the river St. Lawrence. It is estimated that it will cost 2,500,000 dollars, and will be ready for traffic by May 1st, 1935.

LARGE copper deposits have recently been discovered in the valley of the Angren River in the Uzbek Socialist Soviet Republic. According to preliminary investigations, these deposits are estimated at about 1,000,000 tons.

IMPORTS of British coal into Canada through the port of Montreal during the 1932 navigation season set up a new record, and exceeded the 1931 imports by approximately 87 per cent. With navigation closed down on the St. Lawrence for the winter, the imports of Welsh and Scotch anthracite have been summed up at 1,118,287 tons.

THE number of passenger journeys made on the tramways of Great Britain during the year 1931–32 was 4,107,673,072, as compared with 4,394,530,590 in the previous year, a decrease of 6·53 per cent. The corresponding figures for trackless trollies were 184,373,190 and 153,004,554 respectively, an increase of 20·5 per cent.

DURING the first eleven months of last year exports of machine tools from the United Kingdom to countries in Europe totalled £2,564,698; to the Union of South Africa and South-West Africa Territory, £36,326; to British India, £134,184; to Australia, £10,171; and to other countries, £226,138. The corresponding figures for the first eleven months of 1931 were £1,211,060, £66,967, £195,028, £14,703, and £237,900 respectively.

THE total mineral production of Canada during 1932 is estimated to be worth 182,701,000 dollars, as compared with 228,029,000 dollars for 1931. The output of gold amounted to 63,155,925 dollars, an increase of 13·4 per cent. Silver was 5,818,000 dollars, a slight decline; copper, 14,746,000 dollars, a drop of 18 per cent.; and nickel, 6,987,000 dollars, a decrease of about 50 per cent. The coal produced amounted to 11,786,500 tons; natural gas to 23,654,000,000 cubic feet; and the crude petroleum to 1,050,250 barrels.

IN 1913 the total quantity of crude oil refined in Russia was 5,700,000 tons, and in 1931 it constituted 19,900,000 tons, an increase of nearly 250 per cent. In 1913 the production of petrol and ligroine was 204,000 tons, of kerosene 1,521,000 tons, and of lubricating oils 337,000 tons. In 1931 the output of petrol and ligroine was 2,677,000 tons, of kerosene 3,848,000 tons, and of lubricating oils 625,000 tons. The yield of petrol has thus increased from 3·6 per cent. of the total crude oil refined in 1913 to 13·4 per cent. in 1931.

IN addition to the contracts for 150,000 steel sleepers (weighing approximately 9000 tons) required for use with 80 lb. steel rails for the Union of South Africa Railways and Harbour Administration, placed with the United Steel Companies (Workington Iron and Steel branch), contracts for a further 150,000 steel sleepers for 80 lb. steel rails and also 70,000 steel sleepers for use with 60 lb. steel rails were also awarded to Belgian, French, and Luxemburg steel manufacturers, all of whose tenders were lower than those submitted by their British competitors. The contracts for the auxiliary fittings (bolts and clips) required in connection with these 220,000 steel sleepers for South Africa have all been placed exclusively with British manufacturers.

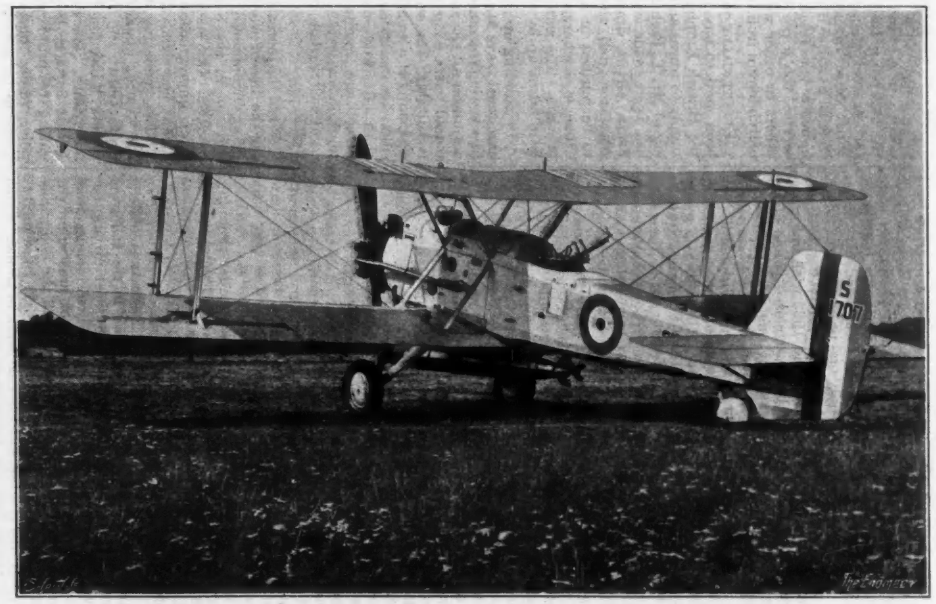
ACCORDING to *Indian Engineering*, extensive tests continue to be carried out in the power-house and on the transmission lines of the Mandi hydro-electric scheme. On November 21st 132,000 volts were put on to the first 59 miles of the transmission line, between Jogindernagar and Kangra. This electrical static pressure is the biggest ever produced by any commercial machine in India. All the tests have proved most satisfactory, and it is expected that by December 20th the power will have been brought as far as Lahore. In the power house the turbines and generators were started up on October 3rd, and since then tests have been carried out. The longest of these lasted sixteen days. Throughout this period the plant continued to run day and night.

SOME BRITISH AIRCRAFT OF 1932

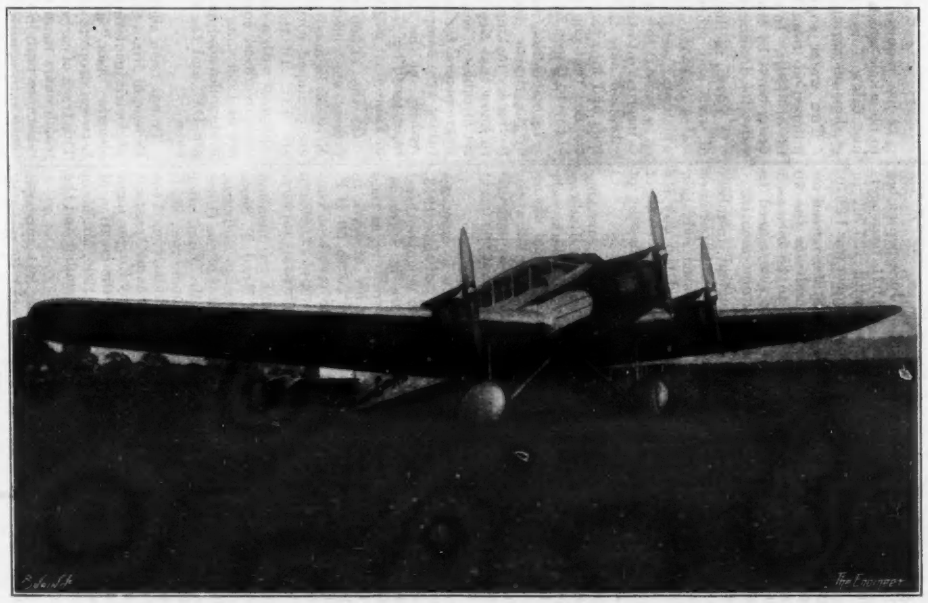
(*For description see page 2.*)

BRISTOL "BULLDOG" SINGLE-SEATER FIGHTER

WESTLAND "WALLACE" GENERAL PURPOSE TWO-SEATER



VICKERS "VILDEBEEST" TORPEDO-BOMBER LANDPLANE



SPARTAN SIX-SEATER CRUISER MONOPLANE

The Engineer

JANUARY 6, 1933.

VOL. CLV. No. 4017

Contents.

THE ENGINEER, January 6th, 1933. PAGE

A SEVEN-DAY JOURNAL .. 1
AERONAUTICS IN 1932. (Illus.) .. 2
LOCOMOTIVE BUILDING IN 1932. (Illus.) .. 4
NAVAL CONSTRUCTION IN 1932. (Illus.) .. 6
HARBOURS AND WATERWAYS IN 1932. No. I. .. 8
ELECTRICAL ENGINEERING IN 1932. (Illus.) .. 9
HUNGARIAN RAILWAYS ELECTRIFICATION. (Illus.) .. 13
RAILWAY AND ROAD MATTERS .. 15
NOTES AND MEMORANDA .. 15
MISCELLANEA .. 15
LEADING ARTICLES—
1932—A Retrospect .. 17
LITERATURE .. 18
SHIPBUILDING AND MARINE ENGINEERING IN 1932 .. 19
LETTERS TO THE EDITOR—
Adjustable Bearings .. 22
The Velox Boiler and Over 100 per cent. Efficiency .. 22
BRIDGE CONSTRUCTION IN 1932. (Illus.) .. 24
WATER SUPPLY AND SANITARY ENGINEERING IN 1932 .. 25
PROVINCIAL LETTERS—
The Midlands and Staffordshire .. 27
Lancashire .. 27
Sheffield .. 28
North of England .. 28
Scotland .. 29
Wales and Adjoining Counties .. 29
PERSONAL AND BUSINESS ANNOUNCEMENTS .. 29
CONTRACTS .. 29
CALENDARS .. 29
CURRENT PRICES FOR METALS AND FUELS .. 30
FRENCH ENGINEERING NOTES .. 31
BRITISH PATENT SPECIFICATIONS. (Illus.) .. 31
FORTHCOMING ENGAGEMENTS .. 32

TWO FOUR-PAGE SUPPLEMENTS—AIRCRAFT, BRITISH AND FOREIGN-BUILT LINERS, WARSHIPS, LOCOMOTIVES, ELECTRICAL ENGINEERING AND BRIDGES.

NOTICES TO READERS.

*** *If any Subscriber abroad should receive* THE ENGINEER *in an imperfect or mutilated condition, he will oblige by giving prompt information of the fact to the Publisher, with the name of the Agent through whom the paper is obtained. Such inconvenience, if suffered, can be remedied by obtaining the paper direct from this office.*

*** *For Subscription rates, see page 2 of Advertisements.*

*** *All letters intended for insertion in* THE ENGINEER *or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

*** *No undertaking can be given to return drawings or manuscripts; correspondents are therefore requested to keep copies.*

1932.—A Retrospect.

WHATEVER 1932 may have been to those who were engaged in a desperate struggle, to the lookers-on, amongst whom we count ourselves, it was a year of great interest. It began badly. The hopes that a real revival of trade had begun were soon dissipated, and, as month followed month, until the summer was over it seemed that this country was either sinking further into the slough, or being dragged into it by the increasing depression in other lands. Then towards the end of the year a little break in the clouds began to make its appearance. A "certain liveliness" became evident. Here and there works reported that their order books were filling up, and almost everywhere "inquiries" which had been allowed to lapse were taken out and looked at again, and a fair proportion of them was converted into orders. Confidence, which for many weary months had been lacking, began to show signs of revival, and in some trades business became almost brisk. In the last week of December industrial stocks showed remarkable improvement, the Stock Exchange value of shares in some engineering firms advancing by nearly 50 per cent. If only this increasing confidence is delivered from any untoward check we may be certain that in the current year will be seen the first sure signs of a trade revival.

If we may have the daring to say so, one of the dangers which menace that confidence is the analyses which are presented by doctrinaire economists. So sure as there is an improvement, these gentlemen apply their principles, statistics, and arithmetic to prove that it is not a real revival at all, but a mere specious improvement due to some half-understood movement of sterling, to the gold standard, to the bank rate, to some foreign political operation, to the season, or what not. We would plead earnestly with our readers to turn a deaf ear to these gloomy economists and apply themselves whole-heartedly to getting things done. The slump has given too much time and too many opportunities to the talker, and the thinker. What we need now are doers. If orders are not placed because the economists tell us that the financial condition of the world is still dangerously unstable we shall make no progress at all. If, on the other hand, orders are placed we are confident that prices will rise and that all the prognostications of the doctrinaires will be defeated by the fact that, despite them, industry is reviving. At this juncture a bold policy, even an adventurous one, will pay us better than "Letting 'I dare not' wait upon 'I would.'"

Protection and Imperial Agreements.

Of the National events of the year none can compare with the re-introduction of a general tariff on imports, and the Ottawa Conference. Owing to world conditions and Great Britain's departure from the gold standard, it is impossible to say as yet whether or not the duties have been beneficial to the industries of this country as a whole, but it is manifest that without them the Ottawa treaties would not have been made, and as those treaties may, in the course of years, bring about an enormous development of inter-Imperial trade, we shall follow our own advice and not look too closely into the economic principles of tariffs. Their immediate effect was the augmentation of protective duties in other lands, but even that has not been entirely bad, for it has so underlined the defects of lofty trade barriers that the movement for their general reduction is making some progress. Such barriers have, says the Economic Section of the League of Nations in its latest annual Review, "undermined established trade and production, aggravated the economic depression in many countries and present a grave obstacle to the return to more normal conditions." The British duties have had another result, of which we may be glad to take present advantage without looking too deeply into its ultimate consequences. Many firms which manufactured abroad and exported to this country when it was a free market have now established industries within the tariff wall. For that we may be thankful. It has given immediate work to structural and equipment engineers, and we leave the question of the effect of excessive manufacturing capacity to settle itself. It is possible, even probable, that in all, or nearly all, these cases the industries are really new to this country and will therefore not interfere with existing resources whilst offering employment to a few thousands of workpeople.

At Ottawa was made the first step in the greatest politico-economic movement since the creation of the United States and the German Empire. But the task which is yet to be accomplished is a stupendous one, of which the ramifications can only be dimly seen. Unlike America and Germany, in which the parts to be welded together lay adjacent to each other, the Dominions are strewn all over the globe and separated by thousands of miles of ocean. To bring these scattered parts into common accord for a single interest is the work that has to be done and on which a start was made at Ottawa. There are those who contend that little or nothing was achieved at the Conference, others who believe that complete disruption of the Empire into separate units is both right and inevitable, and yet others who look with dismay on the effect of Imperial economic unity. No one will be so crass as to deny the enormous difficulties of the task or to assert that the Conference made the future secure. Far, far more remains to be accomplished, but a great beginning was made, and if it be pursued vigorously and successfully the end will confound alike the little Englanders, and foreign nations which fear that an Imperial understanding would damage their national interests. Rather may it be said that an Imperial bond is one of those elements which is essential to the realisation of economic agreements which will embrace the whole world.

Road and Rail.

Another event which gave interest to the year was the publication of the Salter Report. For some time it had become evident that the railways were suffering from the competition of commercial transport on the public highways, and it became necessary to inquire whether that competition was perfectly fair and whether it was in the national interest to allow it to continue without check. A Committee was therefore appointed by the Ministry of Transport to examine the whole matter. The chairman was Sir Arthur Salter and the members were the general managers of the four railway companies and four representatives of road interests. The report, published on August 17th, was unanimous. Having estimated that the annual cost of maintaining the roads of the United Kingdom amounted to £60 million a year, the Committee proceeded to examine the means of raising that sum by taxation of motor vehicles. It found that nearly all commercial freight vehicles were paying too little, some of them far too little. In fact, it appeared that certain classes of road transport were being subsidised and were thus enjoying an advantage over the railways which not only receive no public financial aid, but are heavy ratepayers. Hence a new schedule of taxes for commercial road vehicles carrying freight was presented. The report provoked a storm of protest from road interests, some of which was so obviously based on a misunderstanding that a few months later the Salter Committee found it necessary to issue a memorandum stressing the fact that it was only appointed to deal with, and did only deal with, *commercial* vehicles. Several weeks have passed since that memorandum was issued, and since it has evoked little or no public discussion we may perhaps assume that it is being digested by those who had mistaken the intentions of the original report.

So the matter remains for the moment, and the next step is awaited with some impatience. That step is the decision of the Government on the proposed new taxation. When the Report was published it was circulated amongst interested corporations and institutions, with an invitation to submit their criticisms to the Ministry of Transport, which, it is understood, proposes to review all these criticisms and comments before presenting the matter in the House of Commons. There is a feeling that the delay is causing some injury to industry by arresting orders for new heavy vehicles, and it is to be sincerely hoped that the matter will be settled before long.

During the prolonged discussion on the Salter Report the view gained ground that Government action should be applied rather to reducing the obligations which are imposed upon railways than increasing those on road traffic. Railways were established at a time when other means of inland transport were, by comparison with their potentialities, almost negligible. They therefore enjoyed a monopoly and monopolists are, quite rightly, carefully controlled. The coming of the heavy motor vehicle has diminished that monopoly and it is reasonable, in consequence, to ask for the abatement of the control. Some of that control is inspired by consideration of public welfare, and the State is hardly likely to consider any relinquishment of it. But other forms of control as, for example, those affecting labour and traffic rates might be modified. But, when all is done to relieve the railways of certain burdens, it would seem equitable that the commercial vehicle should pay a larger share than it has hitherto done towards road maintenance. Even if the railways were non-existent or flourishing, that would be necessary in fairness to other road vehicles. The problem is not peculiar to this country, and in others the means which are proposed or are being taken to sustain the railways are stronger than in this. Railways are national necessities and the disablement of them cannot be contemplated with equanimity. Road transport is of unquestionable industrial value and must not be destroyed. Hence the problem is so to organise and control both that the full benefit of each may be enjoyed. We would commend those who desire to understand the world-wide nature of the question to study a paper which Mr. C. E. R. Sherrington, of the Railway Research Service, read before the Yorkshire Branch of the Institute of Transport in November last.

Unemployment.

In this country the volume of unemployment throughout 1932 remained very nearly constant at or about two and three-quarter millions of insured persons. In other countries it mounted rapidly, particularly in the United States. In these circumstances discussions on the causes and cure of unemployment occupied a great deal of attention. Whilst it is, of course, recognised that a proportion, possibly the bulk, of unemployment is due immediately to the world depression, there are many who hold that the capacity to produce is in excess of all probable world demands and that unemployment can only be prevented by a shortening of the hours of labour. There are, however, on the other hand, many who insist that underconsumption, and not over-production, is the cause of both the depression and the consequent lack of employment. The truth in all probability lies, as usual, between the extremes, and a partial cure of the complaint will take place as trade revives. There is, however, a firmly ingrained belief that in this country one million insured persons will be

always unemployed, unless changes are made in the hours of work. We need waste no time on a wrongly conceived Bill for the reduction of hours, which was brought before the House of Commons a few weeks ago. Its avowed purpose was to embarrass the capitalist and its introducer made no attempt to consider the matter on economic grounds. That remains to be done, and will have to be done before many months are passed. The reduction of working hours is a natural corollary to the advance of mechanisation. The objection to it is that it will lead to an increase of the cost of production if weekly wages are maintained at their present level. Hence the problem is an exceedingly difficult and delicate one. If it is to be solved without disastrous friction it will have to be attacked by both employers and employees in a spirit of reasonableness. In a sense it may be said that it is already solving itself, for in this country as well as in other lands the week, if not the day, has already been shortened, sometimes by dropping the Saturday, sometimes by dropping one or more days in the rest of the week. In one or two districts of the United Kingdom, notably in South Wales, a specific attempt to introduce a six hours day is being made.

Another cure which is advanced by those who are not thoroughly familiar with industrial conditions is the arrest of mechanisation and the augmentation of manual labour. We record it here because it was much talked of during the past year, but this is not the place or the time to expose the underlying fallacy of the Erewhonian policy. It is sufficient to say that we cannot look back; we cannot throw away the advantages which mechanisation gives and, if it is causing difficulties, it is not because mechanisation is wrong in itself, but because the world has not yet found out how to make the best of it. But whilst mechanisation is essential, if products are to be available at low prices, and therefore cannot be avoided, there is always the danger that the means of production may outpace the means of consumption. That was another subject which received a good deal of practical attention during the year. A further group of redundant shipyards was purchased and closed by National Shipbuilders Security, Ltd., and several companies which had more than one works shut down some of them so that they might keep the remainder working on full time; the subject of redundant capacity is on the agenda of the National Committee for the Iron and Steel Industry, which appointed its four local committees in June and presented its first report in October to the Import Duties Advisory Committee; in a report on the industries of the North-East Coast, Professor Hallsworth expressed the opinion that the time was ripe for smaller and more compact industries; the efforts, so far unsuccessful, to produce an acceptable scheme for the destruction of obsolete and redundant shipping is yet another indication of a movement which has as its object the utilisation of the best equipment under the best conditions.

It has to be admitted that all these endeavours to augment efficiency and decrease wasteful expenditure led during the year to the displacement of a great deal of labour. But industries cannot be run on the best lines nor be placed in a position to contend with foreign competition if the prime consideration is the giving of employment and not the attainment of the highest productive efficiency. That is a fact which has to be faced. It is even conceivable that it may be better for the nation as a whole to pay out-of-work benefit than to encourage the retention of obsolete manufacturing methods.

The Cunard Liner.

One of the great disappointments of the year was the failure of all efforts to secure means for proceeding with the construction of the great Cunarder on the Clyde, which was stopped in December, 1931. For a short time a report was current that work would be resumed before Christmas, but it turned out to be false, and as the Government resolutely refused to give any subsidy towards the cost of construction the great hull still lies silent upon the stocks. This is the more to be regretted, as the new French liner "Normandie," the largest in the world, was successfully launched on October 29th. Whilst there is not a little doubt about the possibility of operating the new Cunarder, and her necessary sister, economically, it is impossible not to feel that the prestige of British shipbuilding has received a severe blow, and to wonder if, in this case, extravagance would not have paid for itself. It is to be deplored that during a year when this country had not a single really great ship to her credit Italy commissioned two remarkable liners and France launched the most notable passenger ship of the world.

Secondary Effects of Depression.

Whilst the immediate or obvious effects of trade depression cannot escape attention, there are others, less clearly to be seen, which threaten a future danger. The most serious of these is the direct outcome of excessive taxation at a time when the turnover of money is curtailed. When direct taxation is low, prudent firms, even though trade be bad, put something to one side for developments and research. But when 25 per cent. of what small profits they can make now has to be surrendered to the State, nothing can be retained for that very essential work. Furthermore, heavy taxation of the individual checks industrial investments, and, combined with the small inducement which the return on such investments offer, dams the flow of money to manufacturing industries. There are, we fear, little or no grounds for even hoping that the Chancellor of the Exchequer will be in a position to decrease the income tax this year, but if, in consequence of bad trade, he is tempted to raise it still further, the result will be disastrous to industry.

Another of the secondary effects to which we have alluded is the difficulty of training the young men, of all classes, who must carry on the engineering industries in the near future. The number of trade lads who should be serving their time is very much smaller than it ought to be, whilst graduates from colleges who should now be receiving their works training, experience such difficulties in finding vacancies that they are turning to quite other occupations. In these matters, the Government cannot do much, but towards the end of the year several firms took steps to meet the problem, and there is little doubt that schemes under which alternate weeks are worked by apprentices could be developed. The matter is one which, we suggest, should receive the immediate and earnest consideration of the Engineering Employers' Federation.

Conclusion.

We end this Retrospect, as usual, with a reference to the many special articles which occupy most of the pages in this issue. In them a general survey of the technical progress of the year will be found. On the whole, and with certain exceptions, it is rather cheering than otherwise, for it shows that even in a year of profound depression this country carried out a great deal of important engineering work in many fields.

Literature.

Hydromechanische Probleme des Schiffsantrieb herausgegeben. Von Dr.-Ing. G. KEMPF und Dr.-Ing. E. FOERSTER. Gesellschaft der F. und F. der H.S.V.A., Hamburg. Price 19 R.M.

THE "Proceedings" of the Conference on Hydrodynamical Problems of Ship Propulsion, held at Hamburg in May last, under the auspices of the Hamburg Tank, have now been published and contain papers of interest on skin friction and wave resistance, on the theory of propellers, and on the results of experiments in connection with cavitation as experienced with marine propellers.

Papers by Eisner and v. Karman describe the present state of the theory of frictional resistance and of turbulence, and Kempf gives the results of some new experiments made at the Hamburg Tank on the comparative resistances of rough and smooth planes. A paper by Schoenherr describes the effects produced on specific resistance by changes of viscosity due to temperature. The agreement existing at present between calculation and experimental measurements of ship wave resistance and allied phenomena is discussed fully in a paper by Hogner. Weinblum contributes a note on theoretical and experimental comparisons of resistance of forms with straight and hollow water lines, while Wigley gives a comparison of the measured resistances of two models of the same form but on different scales with the calculated wave resistance. Barrillon discusses the problem of the wave resistance of skimming planes.

In the section of the volume dealing with propeller theory Betz describes the fundamental theory of the Voith-Schneider propeller, while Weinig discusses the application to a propeller of measured wind tunnel results with aerofoils in cascade. Gutsche gives the results of some wind tunnel experiments designed to measure the scale effect on model propellers, and mentions that this effect must be seriously considered in connection with tank model propeller experiments. Fraülein Schiller describes the use and the testing of propellers with variable pitch. The question of cavitation is discussed by a number of authors, Ackeret, Föttinger, and Schröter showing examples of erosion produced in pumps, turbines, and valves, while experiments with models in various forms of cavitation tunnel are described by Walchner, Mueller, Martyrer, and Lerbs. Wind tunnel experiments on blades with the object of determining the amount and position of the maximum suction likely to produce cavitation are also the subject of papers by Flügel and Gutsche. Schmidt also describes the effect of cavitation as actually observed in ship trial results.

The last section of the volume deals with non-uniformity of flow, in particular connection with unsymmetrical conditions experienced immediately before a propeller. Horn discusses this subject and Hogner also describes some experiments made to investigate the effect. Gutsche mentions the possibility of scale effect on these conditions, and there also appear papers by Helmbold, discussing the definition of propulsive coefficient, and by Schmierschalski, giving the results of tank experiments on the wake and thrust deduction of a body formed as a solid of revolution as compared with a normal ship form.

Interesting discussions took place on each of these subjects and these are given in full in the published volume. A summary of each paper, translated into English, is also included.

It will be seen that this publication is of particular value to naval architects and students, as it gives a statement of the present position of knowledge of a number of subjects in which great and rapid advances are now being made and concerning which up-to-date information is therefore particularly necessary.

International Handbook of the By-product Coking Industry. Edited by Professor Dr. W. GLUUD. English edition edited by E. M. MYERS, based on the American revision by D. L. JACOBSON. (Translation into English by Dr. A. THAU, Berlin.) London: Ernest Benn, Ltd. 1932. Price £4 4s.

IT may be said at the outset that this volume forms a complete compendium of the by-product coking industry and appears to contain any information that may be required on any point connected with that industry up till comparatively recent times, although some of the latest English work, such as that of Dr. Hickling, is not included. Apparently, in spite of the title page, which gives the names of several German "authors," the work appears to have been done by Dr. Gluud, who writes the preface. It is a great pity that so excellent a piece of work should be marred (at any rate, in the English version) by a number of mistakes and misprints, for which the English Editor, the printers and the printers' proof reader must be held jointly responsible. We refer to such slips as "wether" for "whether" in the preface to the English edition, and, to take a couple of examples at random (page 475), "principle" for "principal," and (on page 680) "was hoil" for "wash oil." Both Dr. Gluud and Mr. E. M. Myers (the Editor of the English version) are at some pains to explain that American orthography has been adopted in preference to English orthography, but this does not account for the fact that we find on many pages the American spelling "sulfur," and, on at least an equal number of pages, the English spelling "sulphur," whilst, on page 57, the two spellings actually appear within two or three lines of each other. We really do not know who is to blame for the description of Fig. 413, where a side-tipping steel truck running on rails is described as a "larry."

As regards the book itself, the work has, for the most part, been exceedingly well done. It is divided into two sections, a scientific and a technical one, the latter being about four times as long as the former. Each deals very thoroughly with its own part of the subject; unfortunately, one of the most important chapters of the book—that on the preparation of coal for coking—is also one of the weakest. It is divided into three parts dealing, respectively, with American practice, European practice, and English practice. The first of these is devoted very largely to the Rheolaveur process, which is described in much detail, but no one reading the description would even guess that the process is a Belgian one invented and worked out in Belgium and only recently imported into the United States. Again, under the head of English practice the process principally described is the Lessing process, which is used only to a small extent in this country, and of which it is said that it "marks an entirely new departure in the preparation of clean coal." Neither Dr. Gluud nor Mr. Myers seems to be aware that a similar process, namely, the floating of clean coal in a strong solution of calcium chloride, was patented by Sir Henry Bessemer in 1858. Again, we find the following statement: "Unlike Continental practice, however, the majority of English plants work on the principle of 'first wash then classify'"; this principle was introduced into England from the Continent by Baum, so that it can hardly be used as a distinctive mark to distinguish between Continental and English practice.

In spite, however, of these and other blemishes, the work as a whole forms an exceedingly complete and valuable guide to by-product coking practice, and will probably prove almost indispensable to everyone engaged in that industry.

Shipbuilding & Marine Engineering in 1932

NO. I.

THE task of reviewing the progress made in the shipbuilding and marine engineering industries during 1932 is not altogether a happy one, as that year was one of the worst, if not the worst, which shipbuilders have ever experienced, not only in this country, but throughout the world. Despite, however, the general lack of work, some notable liners were completed, and others put afloat, but few new ships of importance were laid down, and empty berths were the rule, save in a few yards. Nevertheless, in technical progress the year was marked by advances in hull and propeller design, and in the production of simplified and more efficient propelling machinery of the geared steam turbine, reciprocating steam engine, oil engine and electric propulsion types. Indeed, the advance was so rapid that some shipowners seem inclined to hold back their orders in the doubtful hope of obtaining a ship more economical than that which the yards are now prepared to offer them. The sounder plan, it appears to us, is that which has already been adopted by some British shipowners with success, of adapting the best now offered to meet particular trade conditions; a policy which, when trade returns, will undoubtedly help them to compete more effectively with modernised foreign fleets.

In the end, however, any future revival of British shipbuilding must inevitably turn on the world shipping position and the success of measures taken to bring the supply of shipping tonnage into closer relation with the world's requirements for overseas carriage. The tonnage position has been aggravated by maintaining an ever-increasing uneconomical tonnage by Government subsidy in countries abroad, and we were glad to learn towards the end of the year that, at a meeting of shipowners held at the International Chamber of Commerce in Paris, proposals for the rationalisation of shipping, and the restoration of international trade, were discussed. The report of the Experts' Committee on Shipping and the World Crisis and Surplus Tonnage was adopted by the Councils of the Chamber of Shipping and the International Chamber of Commerce, and it is hoped that some steps will now be taken internationally to re-establish world trade and create a demand for new ships.

The year closed with a more hopeful feeling in the shipbuilding industry. It was engendered partly by the placing of Admiralty and foreign naval orders and by orders for cargo ships and railway steamers placed on the Clyde, and partly by the knowledge that ere long the new naval contracts will be allocated by the Admiralty, and will bring with them, it is confidently expected, long-delayed work for iron and steel works, rolling mills and forges, foundries, shipyards, and marine engine works. The feeling persists that this work and the possibility of beginning work on the Cunarders in the early part of this year would again set the wheels of industry once more in motion, and encourage shipowners to place further orders.

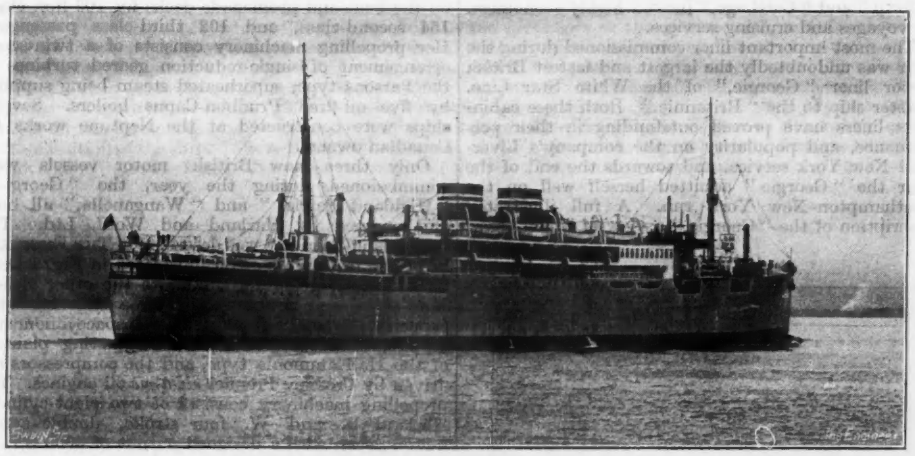


FIG. 1—NELSON MOTOR LINER "HIGHLAND PATRIOT"

The industry has done, and is doing, all that it can through the agency of its self-appointed body —National Shipbuilders' Security, Ltd.—to deal, in an ordered way, with the problem of redundant building capacity. In its two years of activity that company has closed a total of seventeen yards with ninety-one berths capable of an annual output of some 634,000 tons. It is still pursuing its policy of curtailing the capacity of the industry, having due regard to the availability of labour and the facilities in the various localities in which the industry is carried on.

The shipbuilding industry, during the past year, supported the work of the William Froude Laboratory at Teddington, and at the opening of the New Tank, described in THE ENGINEER of November 18th and 25th, we were glad to learn of the increased amount of experimental work on propellers and hulls which is going on, and which has included tests on an entirely new form of hull invented by Sir Joseph Isherwood, of which more will shortly be heard.

In May last an international conference called in Hamburg, under the leadership of Dr. Ing. G. Kempf and Dr. Ing. E. Foerster, dealt with hydrodynamical problems of ship propulsion. Other similar conferences are to be arranged in Holland and in London, and Mr. John de Meo, who has had considerable experience of international conference work, has suggested the co-ordination of technical efforts in an endeavour to deal more effectively with problems yet unsolved.

Some Outputs of 1932.

We do not propose in this necessarily short retrospect to give a full analysis of the number of ships launched and the total power of machinery constructed, but mention may be made of a few of the largest outputs. In many cases the total given includes naval vessels, and these returns clearly indicate the important part played by naval orders in keeping our shipbuilding yards and engine works employed and in preserving shipbuilding and engineering craftsmanship. At the Belfast and Glasgow establishments of Harland and Wolff, Ltd., there were completed six motor ships and steamers aggregating over 54,000 gross tons, with a machinery output of close upon 49,500 I.H.P. On the Tyne, Swan, Hunter and Wigham Richardson, Ltd., launched five ships aggregating 13,304 gross tons, with 14,150 I.H.P. Part of this propelling machinery was built at the Neptune Works of the company and part supplied by the Parsons Marine Steam Turbine Company, Ltd., of Wallsend-on-Tyne. This latter company constructed 12,500 shaft horse-power of turbines, and cut for its licencees over 59,000 S.H.P. of gearing. Palmer's Shipbuilding and Iron Company, Ltd., built two destroyers and constructed 80,000 I.H.P. of naval machinery besides carrying out a considerable amount of dry docking and repair work. Sir W. G. Armstrong, Whitworth and Co. (Engineers), Ltd., of Scotswood-on-Tyne and Walker, carried out an extensive programme of marine conversion work in connection with the Ellerman City Line steamers in which Bauer-Wach exhaust turbine installations were installed in two ships and 165 deg. Fah. superheaters in five others, two of which were further equipped with Howden turbulent flow air heaters and Neil rocker bars. On the Tees, the Furness Shipbuilding Company, Ltd., built four ships, aggregating over 13,100 tons. A large output was that of William Gray and Co., Ltd., of West Hartlepool, where seven ships, totalling nearly 32,000 gross tons, were launched. The machinery for these and other vessels was supplied by the Central Marine Engine Works and totalled seven sets of engines, aggregating over 21,500 I.H.P., several of these engines being of the firm's new high-pressure Quadrupod type, described in THE ENGINEER of July 22nd. On the Tyne, the North-Eastern Marine Engineering Company, Ltd., constructed seven sets of triple-expansion engines, some of these being high-pressure drop valve engines. The same firm supplied no less than 169,000 I.H.P. of superheaters for 168 boilers. On the Clyde, David Rowan and Co., Ltd., constructed ten sets of triple and quadruple-expansion engines, totalling 26,300 I.H.P., most of these engines being

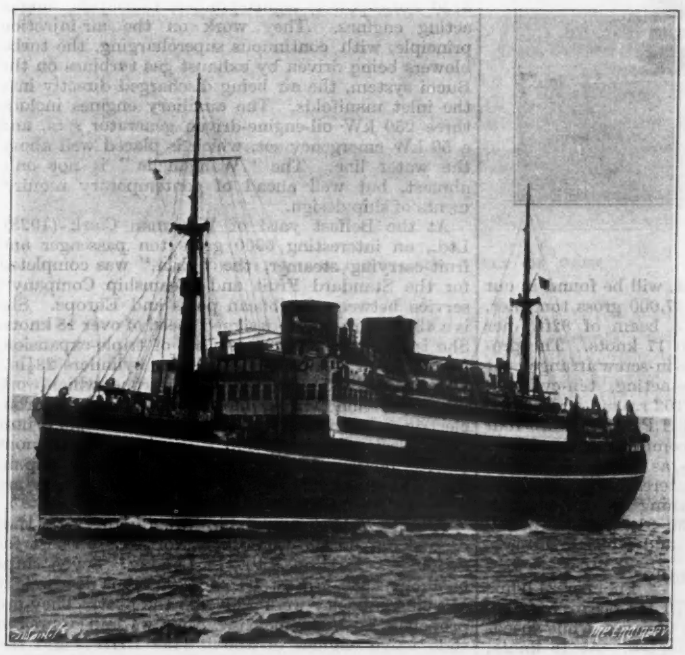


FIG. 2—MOTOR LINER "WANGANELLA"

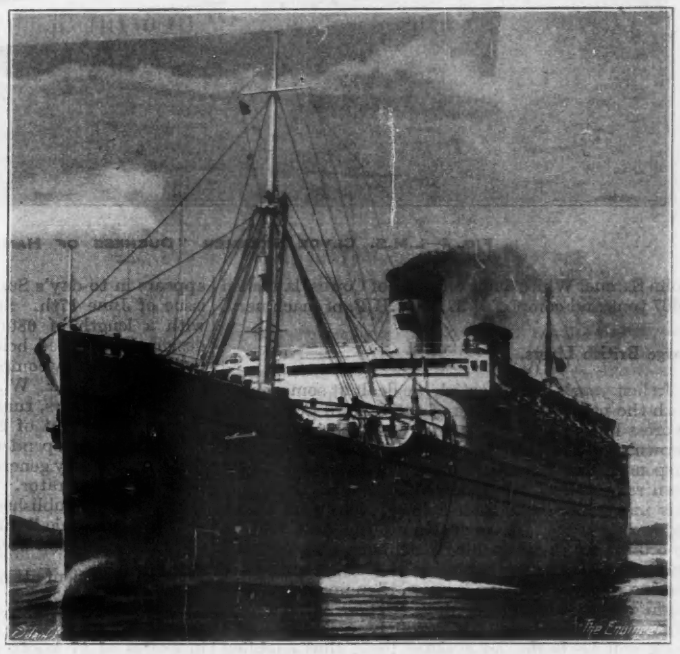


FIG. 3—MATSON LINER "MONTEREY"

for the eight steamers launched by Lithgows, Ltd., of Port-Glasgow, whose output of 41,000 tons was one of the largest of the year. The last few returns mentioned above show clearly the important part still played by the reciprocating steam engine for intermediate and small steamers. Practically no important development connected with the reciprocating type of engine has been neglected, and we shall refer specially to some advances made in this connection in our second article.

Another large output was that of Vickers-Armstrongs, Ltd., at Barrow-in-Furness, at which establishment a destroyer and two submarines were completed, and the machinery for a cruiser was built. The total output aggregated 144,000 I.H.P. At the same yard the 25,000 gross ton new Furness-Withy liner, the "Queen of Bermuda," illustrated in one of to-day's Supplements, was launched and nearly completed. At Birkenhead, Cammell Laird and Co. completed five vessels totalling 12,337 gross tons, with a total maximum I.H.P. of 78,400. This machinery included the quadruple-screw geared turbines for the cruiser H.M.S. "Achilles." Considerable repair work was done at Birkenhead. Other outputs, most of them entirely consisting of naval work, included two "D" class destroyers, built and engined by the Fairfield Shipbuilding and Engineering Company, Ltd., at Govan, representing 2880 gross tons and 72,000 I.H.P., while Yarrow and Co., Ltd., launched 2400 tons and completed 46,700 I.H.P. of machinery, and John I. Thornycroft and Co. 3166 tons and 40,000 I.H.P.

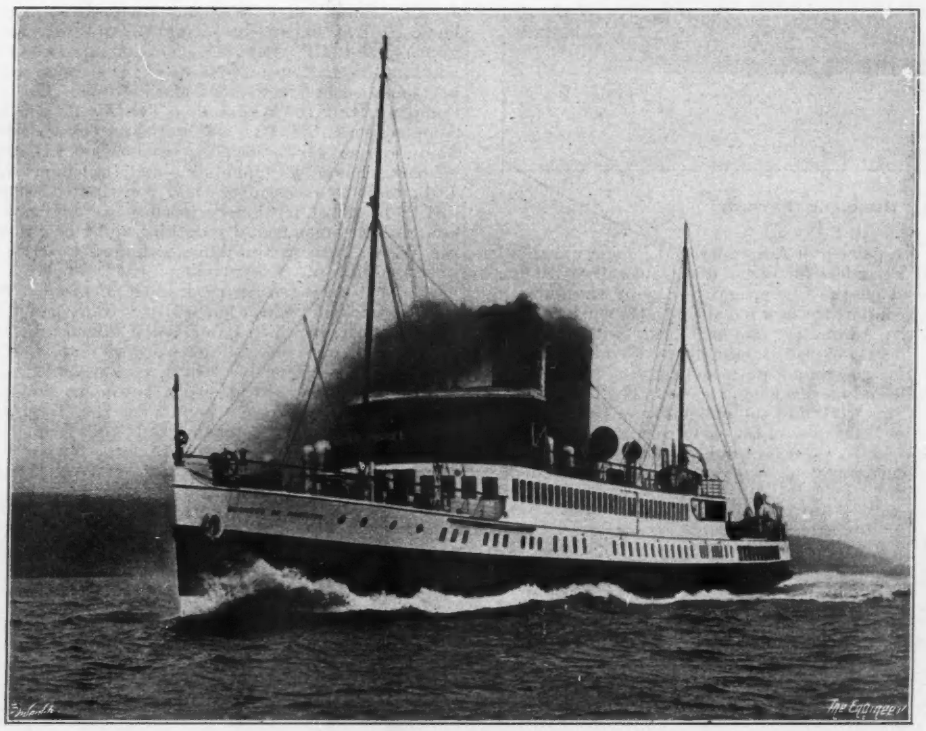


FIG. 4—L.M.S. CLYDE STEAMER "DUCHESS OF HAMILTON"

John Samuel White and Co., Ltd., of Cowes, launched 1667 tons and completed 37,200 I.H.P. of machinery.

Large British Liners.

In last year's annual article we dealt at some length with the principal features of the Cunard Company's express liner "No. 534," under construction at John Brown's Clydebank Yard, work upon which was suspended on December 12th, 1931, and has not been resumed. Little more is to be said concerning this most important British liner. The year's task on her consisted in maintaining the hull and so co-ordinating the propelling machinery and essential auxiliary equipment, that once the decision is made to resume work, as one day it must, then operations can begin within a couple of days. There is no doubt that eventually "No. 534" will be completed and work will be begun on a sister liner, thus enabling three slower ships to be withdrawn from service. The Cunard plan of possessing the fastest as well as the largest and longest liners built is a far-sighted one, and the reasons for carrying it out were set forth in a leading article entitled "Build the Cunarders," which was published in THE ENGINEER of October 7th. During the year there was much public and parliamentary interest in the Cunard liner, and we find very frequent reference to the various steps taken in our Seven-day Journal. We cannot, however, deprecate too strongly the publication of ill-founded statements which more than once during the year appeared in certain sections of the daily Press, only to be immediately denied.

During the year the Canadian Pacific liner "Empress of Britain" proved a very popular and efficient ship, both on her Atlantic and cruising services, and a high overall thermal efficiency was maintained in these services. She is now engaged upon a world cruise, and is running as a twin-screw ship, utilising only the inboard pair of turbines. It will be remembered that the engine and boiler-room arrangement in this ship is so contrived as to divide the total I.H.P. of 63,000 between the inboard and outboard turbines in the ratio of two-thirds and one-third, thus giving 42,000 S.H.P. on the two centre shafts, with full reversing. The 425 lb., 723 deg. Fah. boiler installation is giving very satisfactory results, and with the twin-screw operation a low fuel consumption, which fully justifies Mr. John Johnson's special design, is obtained. The company's other oil-fired "Empress," "Duchess," and "Montcalm" class ships are giving excellent service, as are also the coal-buring, stoker-fired, cargo ships of the "Beaver" class. In the P. and O. fleet the electrically-propelled liners "Viceroy of India," "Strathnaver" and "Strathaird," also the turbine-driven ships "Corfu" and "Carthage," proved highly economical on voyages and cruising services.

The most important liner commissioned during the year was undoubtedly the largest and fastest British motor liner "Georgic," of the White Star Line, a sister ship to the "Britannic." Both these cabin-class liners have proved outstanding in their performance, and popularity on the company's Liverpool–New York service, and towards the end of the year the "Georgic" aquitted herself well on the Southampton–New York run. A full illustrated description of the "Georgic," a view of which vessel appears in to-day's Supplement, will be found in our issue of June 17th. She is a 27,000 gross ton liner, with a length of 680ft. and a beam of 82ft., her designed sea speed being 16 to 17 knots. The propelling machinery comprises a twin-screw arrangement of Harland-B. & W., double-acting, ten-cylinder, two-stroke motors, running at 102 r.p.m., and having a designed output of 20,000 S.H.P. There are four 850 B.H.P. independent air compressors, and four 500-kW auxiliary generator sets, as well as a 75 B.H.P. emergency generator. Some interesting figures have recently been published concerning the performance of the "Britannic" during 1930–31, in which period she made non-stop ocean runs and cruising services. The fuel coefficient attained, namely $\frac{\Delta^{\frac{2}{3}} V^3}{\text{Fuel per 24 hours}}$ worked out at 61,800 to 66,970 for ocean passages and 61,870 for average cruising voyages, while speeds in excess of 17 knots were recorded. At 16 knots, with the engines turning at 86 r.p.m., the fuel consumption per day was 63·34 tons.

Of scarcely less importance is the 20,000-ton electrically propelled liner "Queen of Bermuda," built at Vickers-Armstrong's Barrow yard, and engined by the General Electric Company, Ltd., for the New York–Bermuda service of Furness, Withy and Co., Ltd. She is 575ft. long, with a beam of 76ft. 6in., and a depth of 43ft. 3in., and has a trial speed of 19¾ knots. Her special features include a fore end structure, particularly designed to meet heavy North Atlantic weather, and a new device, on British ships at least, is the use of slots in the funnels to assist in carrying away the smoke and gases clear of the deck spaces. Accommodation is provided for 731 passengers, with a bath-room to each state-room. There are fewer state-rooms than on the sister ship, the "Monarch of Bermuda," and the rooms are consequently more spacious. The propelling machinery is a replica of that which has proved so successful in the "Monarch of Bermuda," and consists of a pair of 7500-kW Fraser and Chalmers–G.E.C. 3000-volt turbo-alternators, running at 3000 r.p.m., driving four 4750 S.H.P., 150-r.p.m. synchronous type motors. There are four 750-kW auxiliary turbo-generator sets and a 45-kW emergency set. The new liner will carry out official trials early this year.

Another liner which we have chosen for illustration in to-day's Supplement is the "El Kantara," built by Swan, Hunter and Wigham Richardson, Ltd., for the express passenger service of the Compagnie de Navigation Mixte, of Marseilles, between Port Vendres and Algiers. She has a length of 400ft., with a measurement of 5079 gross tons, and is designed to carry a total deadweight of 1400 tons on a draught of 18ft. 2in. She has three complete decks running all fore and aft, with accommodation on the boat and promenade decks for 103 first-class, 154 second-class, and 102 third-class passengers. Her propelling machinery consists of a twin-screw arrangement of single-reduction geared turbines of the Parsons type, superheated steam being supplied by five oil-fired Prudhon-Capus boilers. Several ships were constructed at the Neptune works for Canadian owners.

Only three new British motor vessels were commissioned during the year, the "Georgic," "Highland Patriot" and "Wanganella," all built and engined by Harland and Wolff, Ltd. The "Highland Patriot" was described in THE ENGINEER of May 27th, and is again illustrated in Fig. 1 herewith. She is generally similar to the other Nelson Line ships, and is noteworthy for a large insulated capacity, the total refrigerated cargo space amounting to 616,000 cubic feet. The refrigerating plant is of the Hall ammonia type, and the compressors are driven by Crossley Premier *vis-à-vis* oil engines. The propelling machinery consists of two eight-cylinder Harland–B. and W. four-stroke, double-acting motors, each with a designed output of 4600 S.H.P. when running at 105 r.p.m., the designed service speed of the ship being 15 knots. Excellent accommodation for passengers is provided. The "Wanganella"—see Fig. 2—is another important motor ship, which, late in the year, left this country for Sydney, where she will take up the Australian-New Zealand trade of Huddart Parker, Ltd. She was really nearly completed last year, as the "Achimota," but she was not included in our returns and belongs more properly to this year's output. As Fig. 2 shows, she is a typical Harland and Wolff ship, with two squat funnels and lofty superstructure. Besides the four cargo holds, there is accommodation for 304 first-class and 104 second-class passengers, which has been specially designed to meet Australian service conditions. Her propelling machinery represents the latest four-stroke practice, there being two 4250 horse-power, eight-cylinder, four-cycle, single-acting engines. They work on the air-injection principle, with continuous supercharging, the turbo blowers being driven by exhaust gas turbines on the Buchi system, the air being discharged directly into the inlet manifolds. The auxiliary engines include three 250 kW oil-engine-driven generator sets, and a 50 kW emergency set, which is placed well above the water line. The "Wanganella" is not only abreast, but well ahead of contemporary requirements of ship design.

At the Belfast yard of Workman Clark (1928), Ltd., an interesting 6000 gross ton passenger and fruit-carrying steamer, the "Erin," was completed for the Standard Fruit and Steamship Company's service between Caribbean ports and Europe. She is a 431ft. ship with a designed speed of over 18 knots. She is propelled by a single set of triple-expansion, four-cylinder steam engines, having cylinders 28½in., 47½in., 57in. and 57in., with 51in. stroke, which work in conjunction with a Metropolitan-Vickers turbo-electric combination equipment, the complete unit being designed to develop a maximum continuous service power of 6400 I.H.P. at about 90 r.p.m. The 270,000 cubic feet insulated cargo spaces are equipped with Hall CO_2 type refrigerating plant.

A noteworthy cargo ship programme was that carried out on the Clyde and North-East Coast for J. and C. Harrison, Ltd., of London. Seven ships of about 4689 gross tons and 9000 tons deadweight carrying capacity were added to the fleet. They are propelled by high-efficiency Andrews and Cameron slide valve engines of about 3496 I.H.P., and the care which has been bestowed both on their hull and machinery design has made them highly efficient cargo carriers which constitute a definite contribution to our merchant fleet. Two other important cargo ships were the "Kepwickhall" and "Siltonhall," both built by William Gray and Co., Ltd., and engined by the Central Marine Engine Works for the West Hartlepool Steam Navigation Company, Ltd. They are equipped with Quadropod steam engines.

Cross Channel and River Estuary Steamers.

The past year was noteworthy for the number of railway cross-Channel steamers and river estuary boats completed. We illustrate in Fig. 4 the Clyde railway steamer "Duchess of Hamilton," constructed by Harland and Wolff, Ltd., at Govan, for the L.M.S. Railway Company's Clyde excursion services. While

following current practice for such steamers, she is noteworthy for her triple-screw turbine propelling machinery, and a bow rudder, as well as a semi-balanced rudder aft, to facilitate easy navigation. She has a length of over 270ft., with a designed speed of 20½ knots, and proved a very popular ship during the past season. Two other railway steamers are the "St .Andrew" and the "St. David," built and engined by Cammell Laird and Co., Ltd., for the Great Western Railway Company's Fishguard service. We reproduce a view of the "St. David" in Fig. 6. These ships have a length of 335ft., a beam of 46ft. 6in. and a depth of 18ft. 9in., and are propelled by Parsons geared turbines, steam being raised in Babcock and Wilcox boilers. A new feature is the inclusion of a special covered deck for motor cars. During the year William Denny and Brothers, Ltd., of Dumbarton, reconditioned and modernised the three turbine steamers, "Scotia," "Hibernia," and "Cambria," for the London, Midland and Scottish Railway Company's Holyhead–Kingstown route. They are now among the fastest cross-Channel boats in the United Kingdom, their scheduled speed being 25 knots. They are designed to carry 1505 passengers, or some 90 more than before. The express cargo service on this route has also been greatly improved by the addition of the ships "Slieve Bloom" (1930), and "Slieve More" (1932). Fig. 8 shows the latter ship. She from two single-ended return-tube cylindrical oil-fired boilers, working on the closed stokehold system, and give her a service speed of about 17½ knots. She embodies several new features in the arrangement of the covered deck accommodation and public rooms. Two ferry boats of the year are the Chinese train ferry "Changkiang," constructed by Swan, Hunter and Wigham Richardson, Ltd., and "Royal Iris II.," a Harland and Wolff built ferry boat for Mersey river service between Wallasey and Liverpool.

Dredgers and Harbour Craft.

One of the largest dredgers built during the year was the bucket and pump dredger "Belomorskaya," completed by Lobnitz and Co., Ltd., of Renfrew, for Russian service. She has a length of 197ft., a breadth of 40ft., and a depth of 14ft. 9in., with a speed of 8 knots. There are three triple-expansion engines, each of 600 I.H.P., two of which drive either the propellers or the spoil pumps, and the third the bucket chain. Superheated steam is supplied from two 215 lb. pressure cylindrical boilers. The designed output of the dredger is 600 cubic metres per hour, and it is built to discharge the spoil through hinged shoots into barges, or deliver it ashore by means of spoil pumps through 800 m. of floating and shore pipe. The dredger was built to the requirements The pumping machinery has been designed to fill the hoppers with 3500 tons of sand in 50 minutes from a depth of 70ft.

An interesting harbour boat of the year is the tug "Awarua," built by Lobnitz and Co., Ltd., at Renfrew, for the Bluff Harbour Board, New Zealand. She is a twin-screw vessel, propelled by triple-expansion engines, taking steam from two 180 lb. pressure Babcock water-tube boilers, burning coal with induced draught. Although only 130ft. long, with a breadth of 32ft. and a depth of 15ft., she is designed for a speed of 12 knots, and will exert a pull of 12 tons on the tow rope. The "Awarua" is one of the most powerful tugs operating in the Southern Hemisphere.

Other harbour craft of 1932 include two pilot vessels, the "Brook" and "Gurnard," for Trinity House, built by Cammell Laird and Co., Ltd. On the Clyde A. and J. Inglis, Ltd., of Pointhouse, constructed two light vessels, one for the Trinity House and the other for the Commissioners of the Northern Lighthouses. An interesting feature of these ships is the use of Dalzo weather-resisting steel for the hull and framing, and Armco iron for the decks in order to give more durability.

Large Liners Built Abroad.

Whilst British shipping policy is officially opposed

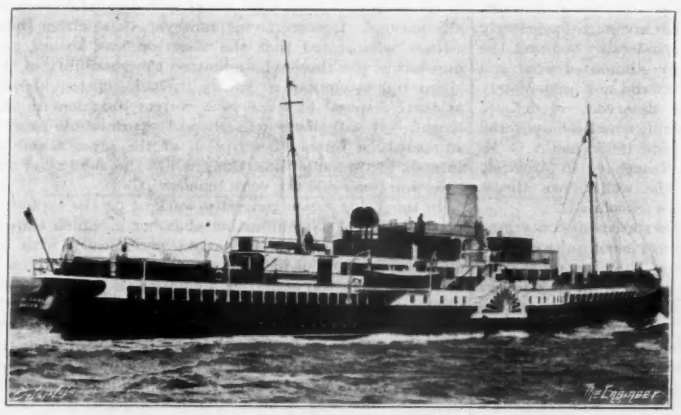


FIG. 5—THAMES ESTUARY STEAMER "ROYAL EAGLE"

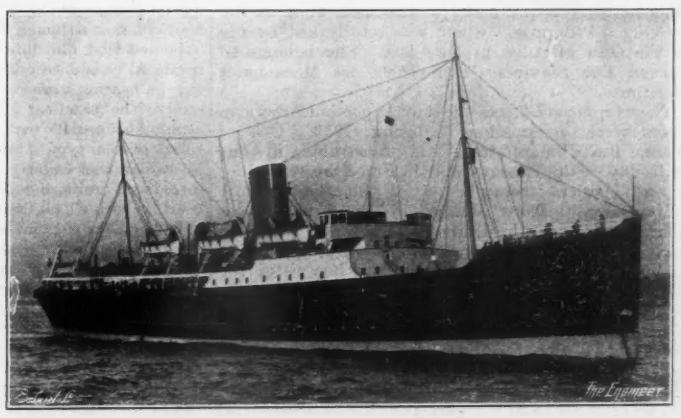


FIG. 6—G.W.R. STEAMER "ST. DAVID"

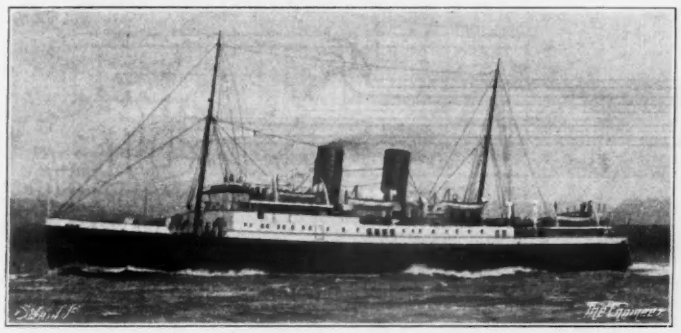


FIG. 7—SOUTHERN RAILWAY STEAMER "ISLE OF SARK"

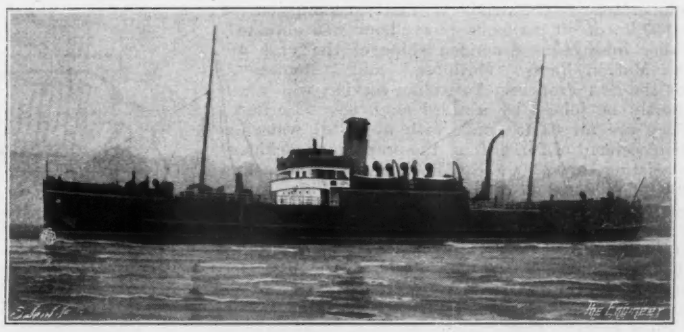


FIG. 8—L.M.S. CARGO STEAMER "SLIEVE MORE"

is a 310ft. ship with a beam of 44ft. 6in. and is designed to carry 935 tons deadweight on a draught of 13ft. The holds and 'tween deck spaces are equipped for carrying 638 head of cattle, appropriate embarking and disembarking arrangements being provided. Her special cargo-handling appliances include two 3-ton luffing and derricking cranes. Both vessels are propelled by twin-screw Parsons geared turbines, taking steam from two 225 lb. pressure Babcock and Wilcox water-tube boilers, designed to burn coal under the closed stokehole, forced draught system. Another outstanding Denny ship is the Southern Railway Company's cross-Channel steamer "Isle of Sark," illustrated in Fig. 7, which took up her Channel Islands service in March last. She is a 2211 gross ton steamer, with a designed speed of 19½ knots, and is equipped to carry 1350 passengers with a crew of sixty persons. Her hull forward is of a modified "Maierform" type, which was adopted in order to reduce her resistance in calm weather, and to improve her sea-going qualities in stormy weather. She is propelled by Parsons geared steam turbines, and Yarrow boilers of the latest type are fitted. The propellers are of a new type, which has been developed after extensive experimental work at the firm's Dumbarton tank.

An acquisition to the fleet of the General Steam Navigation Company, Ltd., is the "Royal Eagle," illustrated in Fig. 5, which entered the company's London, Southend, Margate, and Ramsgate service in the spring of last year. She is a fine example of a modern paddle steamer, and has a length of 289ft. 9in., with a moulded breadth of 36ft. 6in., and an extreme width over the sponsons of 68ft. 10in. Her triple-expansion diagonal engines take steam of Lloyd's 100 A 1 class, and embodies all the latest improvements, including the Lobnitz patented lubricated bottom tumbler, which has given excellent results in practice. At the Renfrew yard of John Simon and Co., Ltd., no large ships were launched, but a considerable amount of dredging material was supplied. A comparatively small, but, nevertheless, interesting bucket dredger was "Tilbury II.," designed for the special work of the Port of London Authority, and built and engined by Ferguson Brothers (Port Glasgow), Ltd. She was described in THE ENGINEER of March 15th, and has a cut-away deck line to enable her to dredge close up to quay walls. Her trials showed that she was capable of dredging to a depth of more than 45ft. below the water line. A further dredger, "Foremost Scot," was completed by Alexander Hall and Co., Ltd., of Aberdeen, for the James Dredging, Towing and Transport Company, Ltd., of Southampton, and will be employed on the new Southampton graving dock. She is a 200ft. ship, with a beam of 39ft. 6in. and a depth of 16ft. 6in., and is of the self-propelling suction type with a reclamation hopper. The propelling machinery has an output of 1000 I.H.P., and was built by the North-Eastern Marine Engineering Company, Ltd. It propels the ship and drives a 27in. dredging pump. The specified dredging depth is 50ft., and the hoppers will carry 1250 tons of spoil. Towards the end of the year, Cammell Laird and Co., Ltd., launched at Birkenhead the large suction sand dredger "Hilbre Island," which is being constructed for the Mersey Docks and Harbour Board. It has a length of 330ft., a beam of 54ft., and a depth of 22ft., and the hopper capacity is about 70,000 cubic feet. to State-subsidised merchant fleets, the carrying out of Government-supported shipbuilding programmes in Europe and America brought into commission during the past year several ships of outstanding merit. That the construction of such vessels, although competitive in their service, was not without some gain to British marine engineers, is shown by the fact that designs for boilers, deck and engine-room auxiliaries, ventilating and heating schemes, forced-draught installations, and cargo-handling appliances, all-British in origin, were specified for these foreign ships, showing the high esteem in which British designs are held.

New French Liners.—Pride of place must be given to the Compagnie Générale Transatlantique or French Line's giant ship the "Normandie," which was successfully launched on October 29th from the Penhöet Shipyard at St. Nazaire. A full description of the launch of this fine ship and of her main turbo-electric propelling machinery will be found in THE ENGINEER of November 4th and 11th. Her owners and builders are to be congratulated on the success which attended the launch of the world's largest ship, and the advanced state of her construction. She has a length of 1027ft., with a beam of 117ft. 6in. at the main deck, with a loaded displacement of 67,500 tons, and her ship's complement will consist of 3490 persons. The special features embodied in her hull form, such as the Yourkevitch lines, the whale-backed forecastle deck, and clipper-like bow, with a widely flared stern, give her a special place in modern liner design. Her electric propelling machinery totals 160,000 S.H.P., there being four motors, one on each propeller shaft, the current for which is generated by four 34,200-kW turbo-alternators,

which will be supplied with steam from twenty-nine water-tube boilers designed for a working pressure of 400 lb. per square inch and a total steam temperature of 662 deg. Fah. The auxiliary generator sets will comprise six 2200-kW geared turbine units, and it seems likely that in the light of recent events on other liners the question of dividing some of the output between turbines and oil engines may be finally adopted. Another outstanding vessel belonging to the Compagnie Générale Transatlantique is the cabin class liner "Champlain," which entered the company's North Atlantic service in June last. She was built and engined at Penhöet, and has a measurement of 24,000 gross tons, with a length of 640ft. Her passenger accommodation is characterised by a pleasingly modern note, and one of her special features is the large free deck space which has been made possible by accommodating the Thermo-tank heating and ventilating equipment in special rooms forward on a lower deck. She has twin-screw Parsons geared-turbine machinery, with 400 lb. pressure boilers, generally similar to those which will be used in the "Normandie." Her auxiliary generators were supplied by Allens, of Bedford, and are among the largest afloat, having each an output of 900 kV. She proved a most successful ship during the year, attaining speeds of over 20 knots.

A large French motor ship of the year is the "Aramis," a vessel of 21,400 tons displacement, equipped with 11,600 B.H.P. Sulzer twin-screw engines. She is pratically of the same type as the "Georges Philippar," which was totally lost by fire in the Gulf of Aden in May last. She belongs to Société Des Services Contractuels des Messageries Maritimes.

New American Liners.—Several important American liners were commissioned during 1932. One of these, the "Manhattan," is illustrated in one of to-day's Supplements, and in Fig. 3 we reproduce a fine view in tropical seas of the Matson liner "Monterey." The "Manhattan" is a cabin-class liner belonging to the United States Lines. She was built and engined by the New York Shipbuilding Company, of New Jersey, and, like her sister the "George Washington," now under construction, has a length of 705ft., a beam of 86ft., and a depth of 47ft., with a measurement of close upon 24,300 gross tons. She has been designed to carry 400 cabin, 500 tourist, and 200 third-class passengers. Her Parsons geared turbine installation has a service rating of 30,000 S.H.P., corresponding to a sea speed of over 20 knots. The boilers are of the Babcock and Wilcox express pattern with 400 lb. working pressure and 682 deg. Fah. total superheated steam temperature. On trials a fuel consumption of 0·597 lb. of oil per horse-power-hour was obtained. Other interesting American ships of the year are the Matson liners "Mariposa" and "Monterey," for the San Francisco-Australian service, which will shortly be joined by a third ship, the "Lurline." They are all 631ft. long, with a loaded waterline displacement of 26,141 tons, the propelling machinery consisting of 22,000 S.H.P. geared turbines and 400 lb. pressure oil-fired boilers, with a final superheated steam temperature of 675 deg. Fah.

Late in the year the Federal Shipbuilding Company, of Kearney, New Jersey, launched the "Santa Elena," the last of four new ships for the Panama mail service of the Grace Lines. These are 18-knot, turbo-electrically propelled liners of 16,000 tons displacement, with a length of 508ft., and a beam of 72ft. The first ship, the "Santa Rosa," sailed for New York at the end of November, and the three other sister ships, the "Santa Paula," "Santa Lucia" and "Santa Elena," will follow early this year.

New Italian Liners.—Considerable interest attaches to the two Italian liners, "Rex" and "Conte di Savoia," which are illustrated in one of our special Supplements. They were both completed shortly before the end of the year, but their two maiden trips were, unfortunately, marred by minor mishaps to the auxiliary plant. The principal generating plant on both ships is turbo-electric, the oil engines being of smaller capacity. It seems likely that in new ships, or even the present ships, the practice of the "Empress of Britain," "Bremen" and "Europa," may be adopted with advantage, utilising oil engine generator sets of larger capacity. The "Rex" was described in our issue of October 7th. She was constructed at the Ansaldo Yard, Genoa Sestri, for the Genoa-New York service of the Italia Shipping Company. Her overall length is 880ft., with a moulded breadth of 97·1ft., and a depth of 47·3ft. She has a measurement of 50,100 gross tons, and her quadruple-screw Parsons single-reduction geared turbines have a designed maximum output of 120,000 S.H.P. and are designed to give her a speed of 27 knots, with a normal output of about 100,000 S.H.P. There are eight double-ended and four single-ended 385 lb. pressure oil-fired water-tube boilers, with a final steam temperature of 390 deg. Fah. The auxiliary generator plant comprises four 1250 kW turbo-generator sets, and two 210 kW Fiat oil engine generator sets.

The "Conte di Savoia," an outstanding liner on account of her Sperry gyroscopic stabilisers equipment, which was fully described in our issue of January 8th and 15th last, was built by the Cantieri Riuniti dell Adriatico at the San Marco yard, Trieste, and engined at the company's San Andrea engine works. Her measurement is given as 48,502 gross tons, and the normal power of her quadruple-screw geared turbines is stated to be 100,000 S.H.P. The boiler installation was designed by Yarrow and Co., Ltd., and comprises ten main boilers with superheaters and air heaters, which work in conjunction with three cylindrical low-pressure auxiliary boilers. The inboard and outboard turbines are accommodated in separate engine-rooms, and there are three boiler-rooms and a room for the auxiliary generator plant, which comprises four 850 kW turbo-generators and two oil-engine-driven generators of the same output. No definite results have yet been published with regard to the use of the gyroscopic stabilisers, but it is understood that trials made on the return voyage shortly before reaching Gibraltar, with a heavy sea, showed the plant to be most effective in reducing the rolling. Another large liner, built at Trieste, is the motor ship "Neptunia," a 20,000-ton, 19-knot liner, engined with quadruple-screw Sulzer type engines of 18,000 S.H.P. This liner and her sister ship, the "Oceania," which will be completed within the next few months, are for the Cosulich Lines Trieste-South American service.

(To be continued.)

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents).

ADJUSTABLE BEARINGS.

SIR,—In a paper by R. G. Boswell, read before the Institution of Mechanical Engineers this year, and published in Vol. 122, page 423, of their "Proceedings," the author writes:—"The experimental inquiries of Beauchamp Tower and the mathematical investigations by Osborne Reynolds are well known to engineers, and need not be commented upon here. It is a matter of interest, however, that although these pioneer investigations clearly indicated that film lubrication considerably reduced the frictional resistance and practically eliminated wear and tear on bearing surfaces, the subject did not immediately receive the practical attention it deserved, no definite attempt being made to design a bearing which incorporated this particular type of lubrication until 1905 when A. G. M. Michell in this country, and A. Kingsbury in America, introduced quite independently the well-known thrust bearings with which their names are associated."

I should like to point out that this statement concerning the first use of self-adjustable bearings is not quite correct.

L. Archbutt and I had in use a Thurston oil testing machine in the locomotive works of the Midland Railway Company at Derby, and it was described in the edition of "Lubrication and Lubricants," the preface of which is dated September, 1899. Here the machine is described as supplied by Messrs. W. H. Bailey and Co.

In the following edition of the above work, the preface of which is dated January, 1907, on page 335 Thurston's machine is described as having had certain alterations made to it. One of those alterations is described as follows:—"This lower brass, in the machine used by the authors, is crescent shape in section, and is supported in a well-lubricated steel cradle *r*, which allows a little side play in the axle-box, and enables the friction surfaces to place themselves in that position which gives the greatest carrying power." Here we have described the adjustable bearing I invented, and described in a treatise, the preface of which is dated January, 1907. The actual drawing was made by me at Derby, and is dated August, 1899. The machine was installed early in 1900.

In the 1927 edition of "Lubrication and Lubricants," page 535, a clear statement is made on this point. It reads:—"When a journal is grasped between two brasses, as in Thurston's oil testing machine, this excentric position cannot be taken up by both brasses unless they are made self-adjusting. In 1899 R. M. Deeley designed the form of bearing shown by Fig. 216, and this was fitted in 1900 to the Thurston machine shown in Fig. 136 on page 435." By a printer's error, this was made 1910.

Another form suitable for thrust bearings was designed by me and fitted to a centrifugal machine at Derby. It is shown in the 1912 edition of "Lubrication and Lubricants," page 474. I have no doubt but that the date of this could be ascertained from Derby. The bearing shown in the 1927 edition of "Lubrication and Lubricants," Fig. 217, page 537, was also fitted to a locomotive, which was figured at the time in THE ENGINEER.

I may say that the manufacturers of the Michell bearing were quite unaware that their patent had been anticipated until it had almost expired, and their attention was called to the fact by one of my assistants at Derby.

I should like to congratulate the Michell company upon the many ingenious and interesting details of design which have rendered the invention so useful.

December 30th. R. M. DEELEY.

THE VELOX BOILER AND "OVER 100 PER CENT. EFFICIENCY."

SIR,—The assertion (see the *Brown Boveri Review* of January, 1932) that the explosion method applied in the Brown Boveri Velox steam generator allows of attaining theoretically efficiencies of more than 100 per cent. referred to the heat content of the fuel injected, has met in the technical Press with about as many refutations as affirmations. It seems to me, however, that neither those writers who stated that the assertion was absurd and impossible, nor those who admitted the possibility of the claim and attempted to justify it, had sufficient details at their disposal to come to a correct judgment in the matter. It will therefore perhaps be permissible to give summarily a further description of the process and to furnish, at the same time, the proof of the validity of our assertion (over 100 per cent. efficiency).

In the Velox steam generator working on the explosion method (Fig. 1) a combustion chamber *a*, which can be closed off by valves, is charged periodically with an explosive mixture of fuel and air, the pressure of which is raised through the action of a compressor *b*. The spark plug *c* then ignites this explosive mixture, which explodes with a consequent rise of pressure in the combustion chamber to a multiple of the charging pressure. Discharge valve *d* now opens, so that the highly compressed gases can expand through heating tube *e*. The gases are not, however, discharged immediately through tube *e* to

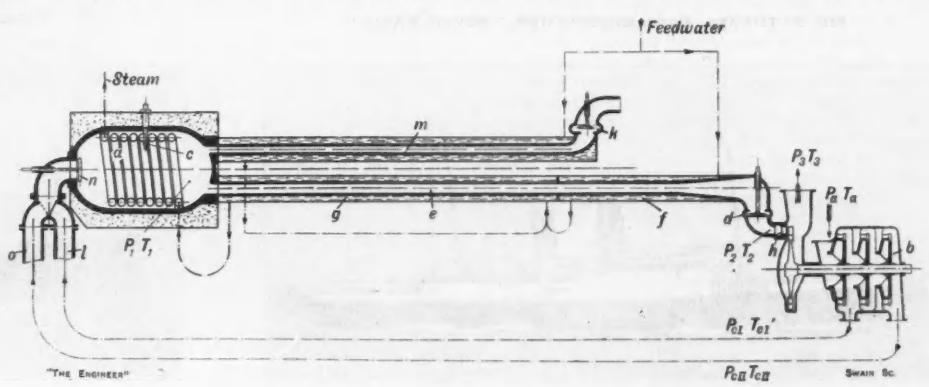


FIG. 1—DIAGRAM OF VELOX BOILER—EXPLOSION METHOD

atmosphere, but are led to the nozzles *h* of a gas turbine. This gas turbine drives the compressor *b* mentioned above.

At its extremity *f* the gas tube *e* is surrounded by a flow of cold feed water, which is thus preheated, and on its length *g* by a flow of the same water which is then vaporised. The steam generator proper is thus really the tube section *g*. All sensible heat is drawn from the hot gases in these pipes and a part of the pressure drop to produce the high speed of the gases is used up here. The remainder of the pressure drop of the gases is utilised in the nozzles *h* of the steam turbine and is transformed into mechanical work on the blading of the gas turbine wheel.

The discharge of gases to the turbine through valve *d* goes on until the gases in the combustion chamber have been expanded down to a certain pressure (scavenging pressure). Valve *d* closes now, and a second discharge valve *k* opens, as well as an inlet valve *n*, which admits scavenging air through pipe branch *l* to drive the residue of the gases out to the atmosphere. This is done through heating tube *m* and the second discharge valve *k*. The residue of the gases is thus expelled and the combustion chamber filled with air. Heating pipe *m* is also surrounded by a flow of feed water, which is preheated in this way and then led to the evaporation chamber of tube section *g*. Once the residue of the gases has been discharged and after valves *d* and *k* have closed the chamber is charged to higher pressure, from branch *o*, after which, all valves being closed, a new ignition and explosion takes place.

The pressure characteristic of the process is shown in the diagram Fig. 2. The abscissæ are the times and the ordinates are the pressures. The example shown in Fig. 2 refers to the same process which is followed in the generator of Fig. 1, namely, the explosion process with separate scavenging and subsequent charging, which process allows, by suitable choice of the cross section of tube *m*, of making the duration of the gas discharge to the turbine the same

as that of the discharge to atmosphere of the gas residue and subsequent recharging.

In Fig. 2, T is the duration of one complete working cycle, T_1 that of discharge to the gas turbine, T_2 that for scavenging, T_3 that for the final charge. Line a is the pressure curve in the combustion chamber (indicator diagram), a_1 is the pressure curve during expansion, a_2 that during scavenging, and a_3 that during charging. Line b_1 is the pressure curve before the gas turbine nozzles. It will be seen that the gas turbine is only under admission during time T_1. If, however, several combustion chambers are utilised—four, for example, as is supposed in Fig. 2—a common gas turbine can be used for all and arranged so that it is under constant admission. The vertical distances between lines a_1 and b_1 give the pressures which are utilised to create the high gas velocity and heat transmission in tube e, Fig. 1. The vertical distances measured on the shaded portions between line b_1 and the atmospheric counter-pressure line c give the pressures which make possible the mechanical work done by the gases in the gas turbine.

Fig. 3 shows the process under the same conditions as

In the example considered here a scavenging pressure of 1·75 atm. abs. and a final charging pressure of 3·5 atm. abs. has been adopted, and 79 per cent. of the discharged gases flow through the turbine. It can be calculated that the work of compression corresponds for a combustion chamber capacity of 1 cubic metre or 3·3 kg. to 64 kg.-calories and can be produced by the gas turbine, on condition that the gases in front of the nozzle still have an average temperature of 45 deg. Cent.

By expansion of these gases in the nozzle from P_2 down to the counter-pressure P_3 (atmospheric pressure), and due to the work they do, the gases cool down to a maximum of 115 deg. Cent. below zero in the first moment of discharge or, in average, to 63 deg. Cent. below zero. After these cold gases have mixed with the other gas residue which was discharged to atmosphere at a temperature brought down to +35 deg. Cent., the total discharged gases attain an average temperature t_3=42 deg. Cent. below zero.

Now, by compression the temperature of the whole charge rises by 87 deg. Cent., so that this charge drawn into the compressor at a surrounding air temperature of, to the gas turbine have still sufficient pressure to do considerable work despite the relatively low temperature to which they have been brought (45 deg. Cent. in the case examined). The compressor set can be considered as being a "heat pump," which, owing to the pressure energy contained in the gas, is able to transform the gas heat (at 45 deg. Cent.), which could not be extracted by any ordinary heat exchangers, into air heat at a higher temperature (107 deg. Cent.).

The heat given up to the boiler, over and above that quantity of the heat contained in the fuel, is supplied by the surrounding atmosphere (by the sun) which must warm up again the cold gases discharged at 42 deg. Cent. below zero to the surrounding temperature of +20 deg. Cent.

It cannot be denied, and, indeed, can be proved by indicator diagram and subsequent calculation, that it is possible to reach pressures in front of the gas turbine nozzle such as are shown in P_2 and to cool down the hot gases to a low temperature by using cold boiler feed water. Further, an explosion pressure of 17·5 atm. abs. with a compression at 3·5 atm. abs. is also practically attainable

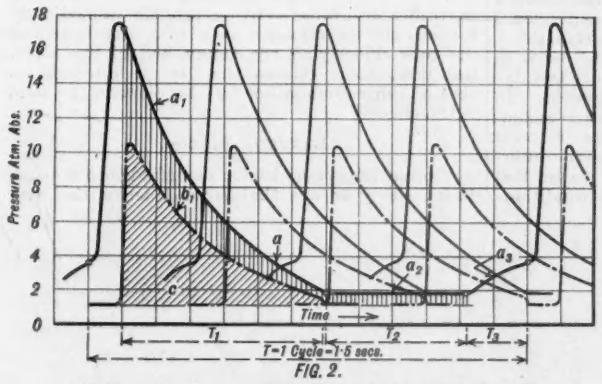


FIG. 2.

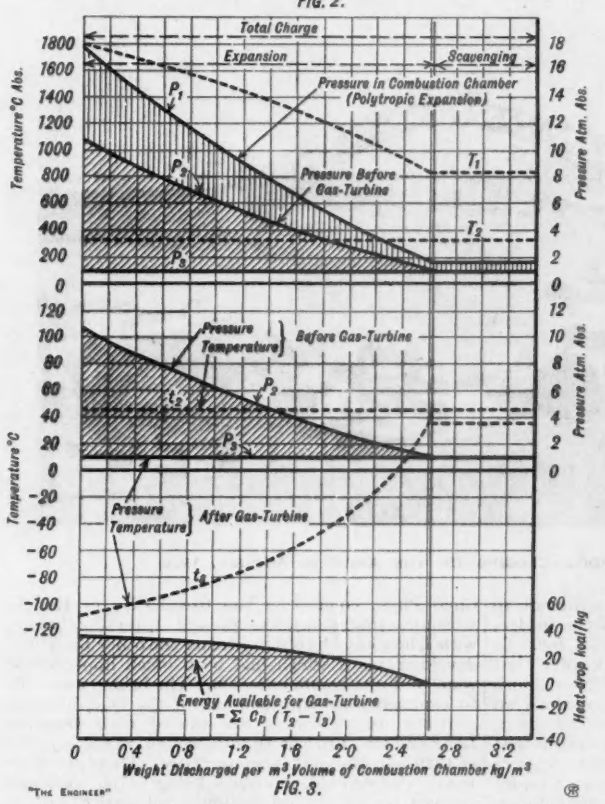
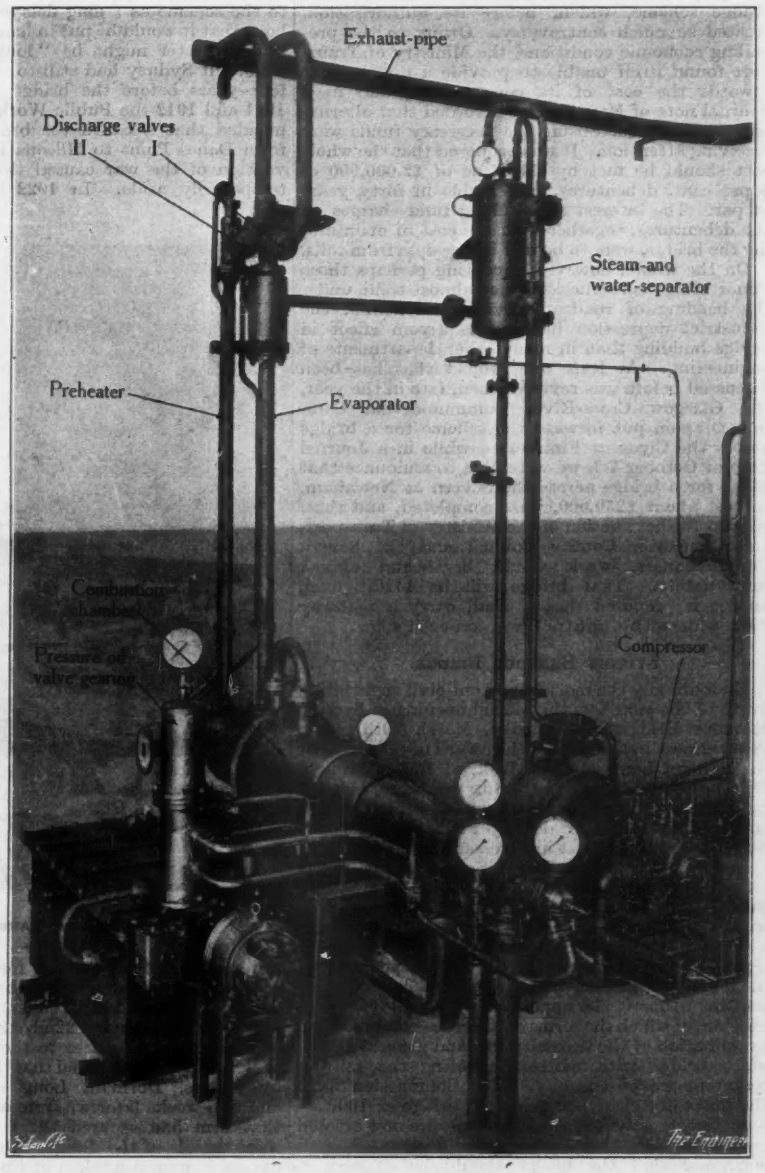


FIG. 3.



illustrated in Fig. 2, but here the quantities (weights) of gases discharged from the combustion chamber are taken as abscissæ and a combustion chamber capacity of 1 cubic metre and a charging pressure of 3·5 atm. abs. are supposed. As the residue of the gases is not discharged to the gas turbine, but is allowed to escape direct to atmosphere, only a part of the load reaches the turbine—in the present case about 79 per cent., which, for the said combustion chamber capacity of 1 cubic metre, amounts to about 2·62 kg. P_1 is the same pressure curve which was shown under a_1 in the pressure-time curve of Fig. 2. P_2 is the pressure curve b_1, also calculated for the new abscissæ.

Admitting that all the heat—under whatever form it is brought into the combustion chamber, with the exception only of the fraction carried away by the exhaust—is absorbed to generate steam, the question of whether the explosion boiler process can attain an efficiency of over 100 per cent. or not (allowing for a perfect gas turbine and perfect compressor—*i.e.*, no losses) can be stated simply under the following form :—To what temperature can the gases which have passed through the generator and which are supplied to the turbine at variable pressure P_2 be cooled, so as to retain sufficient energy for the compression work ? If this temperature is below that of the air supplied from the compressor to the generator, this efficiency will be over 100 per cent.

say, 20 deg. Cent. will be pressed into the combustion chamber at 20+87=107 deg. Cent.; while, as said before, the gases leave the generator proper at 45 deg. Cent.

The following heat balance is thus reached :—

Heat introduced (assuming a usual heat content for the explosive mixture) say=400 kg.-calories per kg. of charge.

Heat introduced due to heating up by compression of mixture $(107-20)\times 0{\cdot}240=20{\cdot}88$ kg.-calories per kg. of charge.

Heat contained in gases leaving generator at 45 deg. Cent. $(45-20)\times 0{\cdot}238=5{\cdot}88$ kg.-calories per kg. of charge.

Heat used in preheating and evaporation, $400+20{\cdot}88-5{\cdot}88=415$ kg.-calories per kg. of charge.

Therefore fuel efficiency $\dfrac{415\times 100}{400}=103{\cdot}75$ per cent.

This efficiency is not at all in contradiction to the second law of thermodynamics, which, as is well known, allows of converting by simple means a smaller amount of heat at a high temperature level into a larger amount of heat at a lower temperature level, the balance being absorbed from the surroundings without any extra expenditure of energy. By exploding the mixture in the combustion chamber, such a high pressure is created that the gases supplied with the assumed mixture of fuel and air containing 400 k.-cal./kg. and a combustion chamber pressure characteristic as given in P_1 can also be realised. It is, however, another question at what efficiency a gas turbine (working under variable pressure) with accessories such as valves, nozzle chests, &c., will operate. Whatever may be said on this point, there is no doubt that the cycle itself is very economical and that a close approach to the efficiency theoretically possible is only a question of design.

An explosion type steam generator working on the principle described here is shown above. It was used to study the cycle. The plant was too small to allow of using a gas turbine. In order, however, to allow of reaching the same working conditions, the gas turbine was replaced by a diaphragm which had the same aperture as the corresponding gas turbine nozzle would have. This generator has been used with lighting gas and with blast-furnace gas. It delivers about 250 kg. of steam per hour, its number of cycles is 50–60 per minute.

For BROWN, BOVERI AND CO., Baden,
W. G. NOACK.

Baden, December 16th, 1932.

Bridge Construction in 1932.

DESPITE the industrial depression, even in some measure because of it, activities so far as the erection, and schemes for the erection, of bridges were concerned were not much impeded. The reason for this partial immunity from the paralysing effects of depression are probably to be found in the fact that many of the bridges now building or completed during the course of 1932 were put in hand in days of greater prosperity. But if some schemes were continued in the face of financial conditions and others started in order to give employment, the development of two important bridge schemes in this country was checked. In the absence of financial support from the Government, the Charing Cross Bridge scheme has not been revived, although it is probable that its protagonists are still working to have the matter reconsidered, while difficulty has been experienced at Hull in financing the Humber Bridge scheme, which, before its authorisation, created so much controversy. Owing to the prevailing economic conditions, the Ministry of Transport found itself unable to provide a direct grant towards the cost of its construction, and in a Journal note of May 13th we recorded that alternative proposals for raising the necessary funds were receiving attention. It was proposed that the whole cost should be met by the issue of £2,000,000 of 5 per cent. debentures, redeemable in forty years at par. The interest and sinking fund charges on the debentures, together with the cost of maintaining the bridge, were to be met by receipts from tolls.

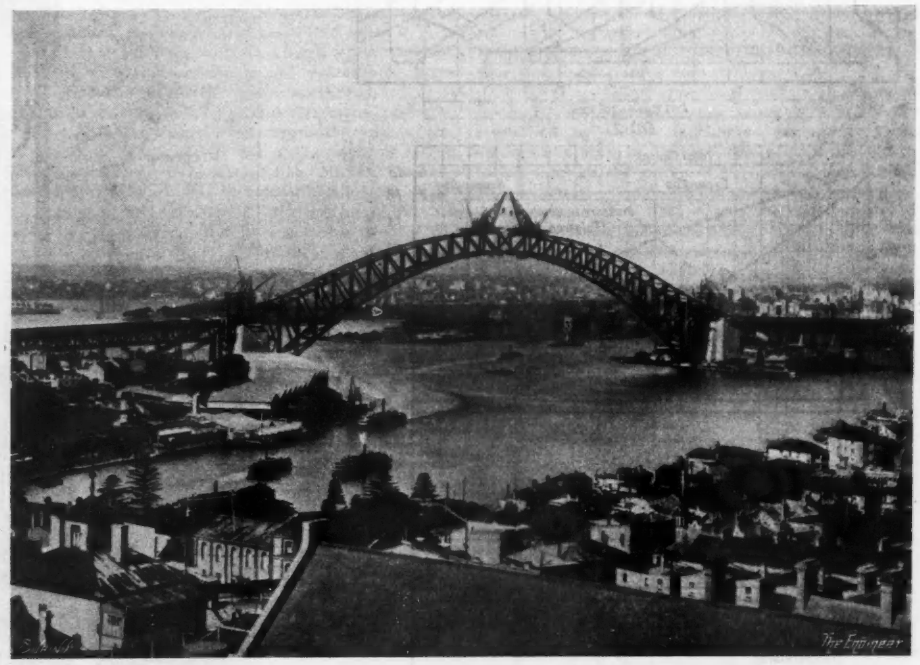
On the whole, however, excepting perhaps those minor bridge constructions that almost come under the heading of road improvement schemes, the industrial depression had a less severe effect in bridge building than in many other departments of engineering. At least one project that has been discussed before was revived when, late in the year, the Glasgow Cross-River Communication Committee again put forward the scheme for a bridge across the Clyde at Finnieston, while in a Journal note of October 7th we were able to announce that plans for a bridge across the Severn at Newnham, to cost about £250,000, were completed, and that, subject to the sanction of the Ministry of Transport, the Gloucester County Council and the Severn Commissioners, work would be begun almost immediately. That bridge will be 1410ft. long, and it is proposed that it shall carry a roadway 20ft. wide with a 5ft. pathway on each side.

SYDNEY HARBOUR BRIDGE.

Undoubtedly the most important civil engineering event of the year was the official opening of Sydney Harbour Bridge on Saturday, March 19th, eight years almost to a day after the award of the contract to Dorman, Long and Co., Ltd., of Middlesbrough. By the courtesy of that firm, we were able to publish a very full description of the bridge and its construction, and its details will be sufficiently remembered to make it unnecessary to repeat them.

The need for a bridge across Sydney Harbour was felt as long ago as 1815, and the necessity that it should not interfere with navigation within the port was also realised. It was for the latter reason that a proposal put forward in 1878 for the erection of a floating bridge was rejected. Twelve years later, in 1890, the matter had become sufficiently important to merit the appointment of a Royal Commission, of which the terms of reference combined the examination of the necessity for, and general details of, a bridge with matters affecting the railway requirements of the city. The Commission fixed the necessary clearance below the bridge at 160ft.—only 10ft. less than that of the structure now erected—if navigation was not to be obstructed, and suggested that the bridge should be erected, if possible, in one span. We mention this suggestion as it is interesting to realise that, in spite of the fact that our recent advances in metallurgy were not then available, the project of a bridge with a single span of as much as 1650ft., though considered bold, was not by any means regarded as impracticable. Having gone so far as to fix the general requirements of a bridge at the proposed site, however, the Commission was of the opinion that the carrying out of the construction was inexpedient at that time. Following the issue of the Commission's report, one proposal after another was put forward and rejected, and the controversy was only partly stilled in 1900 by the issue of an advertisement in the Government *Gazette* calling for competitive designs for a bridge with a headway of 180ft. over the central 600ft. of the span. On May 17th, 1901, tenders were invited for a bridge with a main span of 1200ft., the central 600ft. of which were to provide a headway of 170ft. Several firms, British and foreign, tendered, and after due consideration the offer made by J. Stewart and Co.—an Australian firm—was chosen, subject to certain modifications. The bridge proposed was of a cantilever type. By the time the modifications had been made and the necessary negotiations concluded between Messrs. Stewarts and the Advisory Board which recommended the acceptance of their tender, the country had, however, entered upon a period of trade depression, and the Government found itself unable to proceed with the scheme, and allowed it to lapse. The project, however, was by no means regarded as dead, and our issue of November 6th, 1908, includes an article, the writer of which would seem to have been resident in Sydney. It was pointed out in that article that the prosperity and population of Sydney was growing, and that North Sydney, previously regarded as little more than a suburb, was growing three times as fast as the city itself. At the time of writing, another Royal Commission was sitting to examine alternative proposals for a bridge and a tunnel, and the author of the article rejected the tunnel proposal on the ground that it would be unable to carry two lines of railway in addition to a road. It is interesting to observe that in a final paragraph he referred to the scheme as "long delayed," and expressed a hope that it would be put in hand at an early date.

The matter might be "long delayed," even in 1908, but Sydney had still to wait another twenty-four years before the bridge was completed. In 1911 and 1912 the Public Works Committee recommended that a cantilever bridge should be built from Danes Point to Milsons Point, but the intervention of the war caused the project to be laid temporarily aside. In 1922 economic conditions were sufficiently recovered for the Government to pass an Act authorising the building of the bridge, and in January, 1923, tenders were called for. In our issue of February 22nd, 1924, we recorded that Mr. Bradfield, Engineer to the State of New South Wales, had recommended that the tender put forward by Messrs. Dorman, Long should be accepted, and two weeks later we were able to announce that that firm had secured the contract, and to give some details of the design. On this page we reproduce a photograph taken just before the final closing of the arch on August 19th, 1930, while in one of our Supplements there is another view of the structure nearing completion. Sydney Bridge ranks as the second longest single-arch bridge in the world, and in respect of traffic carrying capacity, weight of steel, and headway, is far in advance of any other bridge of its type.



SYDNEY HARBOUR BRIDGE—CLOSING OF THE ARCH IN AUGUST, 1930

THE BENUE BRIDGE.

All other bridges of the year must, to a certain extent, be overshadowed by Sydney in importance. But it was not by any means the only bridge of note to be opened within the Empire. The year saw the erection of the Benue Bridge in Nigeria, brought to a successful conclusion by Sir William Arrol and Co., Ltd. This bridge, for which Messrs. Coode, Wilson, Mitchell and Vaughan Lee, in association with Messrs. Mott, Hay and Anderson, were the engineers, was officially declared open by Sir Donald Cameron, Governor of Nigeria, on May 24th. A photograph of it taken in February, 1932, when the work on the longer spans was still proceeding, is reproduced in a Supplement accompanying this issue. The bridge forms an important connecting link on the railway line between Port Harcourt on the coast, Makurdi on the Benue River, and Kaduna, a town lying a further 200 miles inland. The respective railheads had both reached the river by 1923, but for reasons of economy the construction of the bridge was delayed, although the preparatory work begun before the war, such as the sinking of boreholes to discover the nature of the river bed and observations of the river to determine the flood seasons and the maximum flood levels to be expected, was continued. The shifting of sandbanks steadily down stream, however, threatened seriously to interfere with the ferry service, and in 1927 it was decided to proceed with the building of the bridge. At the position chosen, the Benue River, elsewhere much broader, passes through narrows barely half a mile in width, and the total length of the bridge between abutments is 2584ft., covered by ten spans of 180ft. and three through-spans of 240ft. A 3ft. 6in. railway track, and a roadway 18ft. wide between kerbs, are carried by the bridge, while the three central through spans provide sufficient headway for the navigation of the river. Building was carried out by the use of two temporary erection spans, which were floated on pontoons into position between the piers as required. The design and erection procedure of the bridge were affected by the presence immediately beneath the three longer spans of a deep chasm in the rock underlying the sandy bed of the river. Unusually large caissons had to be provided to obtain a firm foundation for the piers on the sand in the chasm.

BANGKOK BRIDGE.

Another important bridge described in our pages during the year was that erected across the river Chao Phya, connecting the Royal City of Ratana Kosindra (Bangkok), the present capital of Siam, with Dhonbini, the old capital on the other bank, the development of which had been much impeded for want of direct communication. The bridge was built to commemorate the founding of the city, and the contract for the work was placed with Dorman, Long and Co., Ltd., of Middlesbrough, in the summer of 1929. In design it is symmetrical. There are three spans, the two side openings being 247ft. wide and covered by fixed through-type steel lattice girders, while the central opening of 196ft. is spanned by a double leaf bascule. The bridge and its approaches accommodate a roadway, 33ft. wide between kerbs, with cantilevered footwalks, 8ft. 3in. wide, on each side. Besides the bridge itself the works include approach viaducts on each side, river walls and stairways, and four pontoon landing stages.

LONDON BRIDGES.

To return once more to this country, there is to-day, as perhaps there has always been, acute controversy over the matter of bridges spanning the Thames in the London area. The Government's announcement towards the end of 1931 that it was unprepared, in view of the economic conditions, to provide funds towards the construction of a new Charing Cross Bridge, caused that project to be dismissed at least for the moment, and concentrated attention on Waterloo Bridge. Early in the past year discussions between the London County Council and the Ministry of Transport took place with regard to the future of that bridge, and anxiety was expressed in some quarters as to the general condition of the wooden supports. At the end of January Sir Percy Simmons, chairman of the Improvements Committee of the London County Council, announced that, in the opinion of the Committee, the only satisfactory

solution to the problem was to erect a new bridge to carry six lines of traffic. He was of the opinion that to build a new Waterloo Bridge would cost only about £250,000 more than to re-condition the old, and that traffic conditions required it. The Committee's proposal was subsequently adopted by the Council in spite of considerable opposition. The opposition contended that the cost of a new bridge had been underestimated; that the old bridge might easily be underpinned; and that a bridge wide enough to take six lines of traffic would cause serious congestion at the point where the approach to the bridge joins the Strand. The Ministry of Transport, however, appeared to be willing to make a grant of 60 per cent. towards the cost of carrying out the plan. Opposition was soon forthcoming from many other quarters. At the end of April, for instance, the London Society met to protest against the proposal, and passed a resolution condemning it. The controversy was calmed when the House of Commons rejected the necessary Money Bill containing the proposals of the London County Council by a majority of 68 votes, in spite of the fact that Sir George Hume, representing the London County Council, stated that it had been warned by engineering authorities that the effective life of the bridge was coming tc an end. A month later we were able to report that, as a result of discussions, the Minister of Transport had requested the Council to prepare up-to-date estimates of all practical alternatives to demolition, and the Committee of the London County Council, which recommended that the request be complied with, suggested that the estimates should include one for replacing the worst piers and arches by steel girders and temporary supports, the stones of the old arches to be stored against the possibility of later use. Towards the end of November Mr. Stanley Baldwin, Lord President of the Council, and Mr. Pybus, the Minister of Transport, received a deputation from the London County Council. At that meeting Sir Percy Simmons summarised the steps that had been taken, and asked that the London County Council might be informed what the next step should be. Mr. Baldwin, in reply, stated that the matter would receive the early consideration of the Government. Up to the date of writing no further significant action has been taken. Impatience is often expressed at the series of delays that have occurred without any decision having been made with regard to Waterloo Bridge. It deserves to be pointed out, however, that the matter is of very great importance, and many alternatives exist. Such long delays are by no means unparalleled. The first Royal Commission to examine the proposal to bridge Sydney Harbour was appointed in 1890, no less than forty-two years before the completion of the structure. The history of many other important bridges shows the same delays, and as a notable example we may recall that the widening of London Bridge was first mooted in 1853 and that forty-seven years elapsed before it was sanctioned, and four more before the work was completed.

Charing Cross and Waterloo provide the major problems as far as London's bridges are concerned, and have done so since, in 1928, the London County Council decided to demolish the old Lambeth Suspension Bridge and to replace it by a new one, better adapted to suit modern conditions. The new Lambeth Bridge, which was opened by His Majesty the King on July 19th, meets the requirements of the new office and other development schemes in the Millbank area. In view of its usually deserted appearance, it carries a surprisingly large amount of traffic. Designed architecturally by Sir Reginald Blomfield, in association with Mr. Topham Forrest, and from the engineering standpoint by Sir George Humphreys, M. Inst. C.E., its construction was carried out by Dorman, Long and Co., Ltd. The new bridge consists of five spans, 125ft., 149ft., 165ft., 149ft., and 125ft. long respectively, the total length being 776ft. About 4000 tons of steel are included in the structure, which carries a deck, 60ft. wide, divided into a roadway, 36ft., and two footways, 12ft. wide. A photograph of the finished bridge is reproduced in one of to-day's Supplements.

Water Supply & Sanitary Engineering in 1932

BEING principally under the control of public authorities, water supply and sanitary engineering works felt the full force of the economic conditions of 1932, and many schemes which might have been put in hand during the year were temporarily laid aside, while work on others was either suspended or reduced to a minimum. In the latter category comes the Haweswater scheme of the Manchester Corporation, the only work undertaken being the construction of the northernmost section of the aqueduct. In this section the Mardale Tunnel, 4·8 miles long, is being attacked from each end and the lengths driven to date are 2020ft. from the north portal and 4080 yards from the south. Two important undertakings were described in our pages during the year. At Surbiton (THE ENGINEER, October 28th, 1932) the old beam pumping engines and Cornish boilers have been replaced by turbine-driven sets and water-tube boilers. In our issue of July 8th we published a description of the recently inaugurated Hodder water supply scheme of the Fylde Water Board. This scheme helps to provide a water supply for an area of 207 square miles lying between the river Ribble, the foothills of the Pennine Chain, and the sea on the north and west. It was found necessary to proceed with the scheme owing to the rapid growth of the seaside resorts of Blackpool, Lytham St. Annes, and Thornton-Clevelys. Under an Act of 1912 the Fylde Water Board was empowered to take, collect, and impound the head waters of the river Hodder, and to construct three reservoirs of a combined storage capacity of 3151 million gallons, together with service reservoirs and aqueducts. When the time came to put the scheme into effect it was found possible to impound all the water in one reservoir—Stocks—which holds 3069 million gallons and the other storage reservoirs were not constructed.

Besides that mentioned in the previous paragraph much interesting work was in progress or was completed during the year, while several new schemes were proposed or were put in hand.

London.

On account of the enormous quantity of water involved and the large population supplied—over 7 millions according to present estimates—the doings of the Metropolitan Water Board of London must take first place in interest. The following details of the work carried out in 1932 are taken partly from the annual report of the Board for the year ending March 31st last and partly from information supplied by Mr. H. E. Stilgoe, Chief Engineer to the Board, to whom our thanks are due.

Deptford Pumping Station.—The new station was officially opened on June 15th, 1932, by R. W. James, Vice-Chairman of the Board. The machinery, consisting of a large reciprocating engine with steam turbines as standbys (descriptions of which have been given in THE ENGINEER) is now in continuous operation and performs the duty of the five stations formerly comprising these works with a considerable saving in cost.

Honor Oak Pumping Station.—An oil engine-driven centrifugal pumping unit was installed at Honor Oak. The machinery consists of a high-compression oil engine driving centrifugal pumps capable of supplying 12 million gallons per twenty-four hours when working in parallel or 6 million gallons per twenty-four hours when working in series. River Thames water delivered into Honor Oak reservoir from Walton can be re-pumped into the Greenwich, Woolwich, and Plumstead area of the Kent District or into the North Woolwich, Silvertown, Canning Town, and Dock Area of the Northern District. The contractors for the machinery were Ruston and Hornsby, Ltd., and the alterations to the buildings were carried out by George Parker and Sons, Ltd.

Kempton Park Pumping Station.—The Board has sanctioned the installation of additional pumping machinery at Kempton, consisting of two steam turbines driving centrifugal pumps, each capable of pumping in series or in parallel 12 million gallons or 24 million gallons per twenty-four hours, the total water horse-power being 2016. These pumps will assist the work of the station and act as standbys to the large reciprocating units installed a few years ago and will also be used for re-pumping water filtered at Hampton and delivered to Kempton by low-lift pumps.

Hampton Pumping Station.—The work of replacing the three old Cornish "Bull" engines is nearly completed. The new machinery consists of a 500-kW oil engine-driven generator driving two centrifugal pumps together capable of pumping 12 million gallons of unfiltered water per twenty-four hours to the high-level filters and one centrifugal pump to deliver alternatively in series 5 million gallons of filtered water per twenty-four hours against a head of 300ft. or in parallel 10 million gallons per twenty-four hours against a head of 150ft.

Surbiton Pumping Station.—The work of remodelling and combining the old Lambeth and Chelsea stations at Surbiton is almost completed. The main portion of the work was officially opened on November 1st, 1932, by the Minister of Health, the Right Hon. Sir Hilton Young, and the first portion of the machinery, consisting of steam turbines driving centrifugal pumps of 4900 water horse-power, was set to work by Lt.-Col. Sir George Handover, Chairman of the Works and Stores Committee, and Lady Handover. Old machinery is now being removed to make room for the second portion of the new machinery consisting of low-lift pumps for raising filtered water from the low-level beds to the suctions of the high-lift engines and unfiltered water from the low-level to the high-level reservoirs. A full description of these works appeared in the issues of THE ENGINEER of October 28th, 1932, page 428, and of November 4th, 1932, page 552.

Brixton Pumping Station.—In connection with the remodelling of these works a contract has been entered into with Mr. J. F. Mackenzie for the erection of the engine-house, which is now almost completed. W. H. Allen, Sons and Co., Ltd., are the contractors for the supply of the new machinery, which consists of six oil engines driving centrifugal pumps of a total water horse-power of 880. The erection of the new machinery will commence at an early date. The pumps will replace the existing steam-driven engines and will pump filtered water to service reservoirs at Norwood, Selhurst, Streatham, Rock Hill, Forest Hill, and Crystal Palace.

Walton Pumping Station.—Additional pumping plant will shortly be installed at Walton for raising water from the river Thames into the Molesey, Walton, or Island Barn reservoirs. The machinery will consist of a steam turbine driving centrifugal pumps capable of pumping in parallel 18 million gallons per twenty-four hours into the Molesey reservoirs or in series 9 million gallons per twenty-four hours into the Walton or Island Barn reservoirs. This unit will also drive an electric generator for providing power to run the air compressors for the prefiltration plant and other purposes.

Although not strictly speaking within the limits of an article concerned with 1932 alone, some of the statistics in the Board's report for the year ending March 31st deserve mention. The Board was responsible, during the year, for supplying 280·77 million gallons per day, representing an average of 39·02 gallons per head per day to a population estimated at 7,147,019. Bulk supplies totalled 1,349,323,000 gallons, or 1·31 per cent. of the total. The water was drawn from the Thames—61·3 per cent.; from the Lee—22·7 per cent.; and from wells and other sources—16 per cent. The natural flow of the Thames during the year (582,347·9 million gallons) represented a yield of 10·43in. of rain from the 3855 square miles of watershed area, or 37 per cent. of the general precipitation, while the natural flow of the Lee (41,077·3 million gallons) represented a yield of 6·85in. of rain from 414 square miles of watershed area, or 26·0 per cent. of the general rainfall of 25·87in. Distribution of the rainfall throughout the year was abnormal, as the summer months provided no less than 8·97in. more than the winter, whereas in a normal year the winter months give 2·47in. more than the summer. Rainfall was rather less than 1 per cent. above normal.

A considerable amount of work was done in connection with the disposal of the city's sewage, and it is interesting to learn that the construction of escalators at several tube stations necessitated diversions of a number of main sewers. The following information was supplied by the chief engineer to the London County Council:—

Abbey Mills Pumping Station.—The installation of four electrically driven centrifugal pumps, each of 125 tons per minute capacity, in substitution for old beam engine sets, was begun. When this work is completed, the total pumping capacity of the station will be 2100 tons per minute.

Lots-road Pumping Station.—Five new oil-driven centrifugal storm water pumps, each of 175 tons per minute capacity, have been installed, increasing the capacity of the station to 1130 tons per minute. The Walham Green storm relief sewer, 7ft. and 9ft. in diameter and about 1 mile in length, from North End-road to Lots-road pumping station, was completed.

Deptford Pumping Station.—The reorganisation of this station was completed by the installation of five oil-driven centrifugal storm water pumping sets, increasing the capacity of the station to 1200 tons per minute.

West Middlesex Sewage Scheme.

The outward extension of London is making necessary the provision of sewage disposal schemes in the County of Middlesex, and work upon one such scheme of very great importance was started during the year. This—the West Middlesex Sewerage Scheme—concerns the outer north-western area outside the boundaries of London proper. The population of this area of 102,605 acres, which lies roughly between the rivers Thames and Lee, amounted in 1921 to 504,392 persons, but the rate of increase has been such that in 1928 646,100 people were resident in the district, and it is estimated that when fully developed the potential population of the area will be 1,875,000. At present the needs of the district are met by several sewage schemes, discharging their effluents into the rivers Thames, Lee, Colne, Crane, and Brent. The rate of increase of the population obviously necessitated that special measures should be taken to deal with the sewage. The scheme now being carried out, at an estimated expenditure of £5,250,000, will bring all the sewage of the district to a site at Mogden, between Isleworth and Twickenham, and discharge the purified effluent into the Thames above Kew Bridge.

Progress in construction work was rapid during the year under review. Thirteen contracts for main sewers, of a total value of approximately £1,500,000, have now been entered into, and an aggregate length of about 16 miles of sewers, varying in diameter from 2ft. to 9ft., was completed. Further contracts are being prepared by the consulting engineers, Messrs. Dodd and Watson, in order that the rate of con-

struction work shall be continuously maintained during the period of four years, ending October, 1935, allowed for the work.

At the site of the sewage purification works the main excavation contract was practically completed. About 650,000 cubic yards of material were removed in a little over twelve months, and it is anticipated that contracts embracing the construction of the purification plant will be entered into in the near future.

Provincial Schemes.

In the following paragraphs we give some brief notes regarding the more important work carried out during the year on a number of water supply and sewerage schemes in this country.

Belfast.—The Silent Valley reservoir, to which reference has been made in our pages at various times in the last few years, was completed during 1932. It was filled to capacity (3000 million gallons), and began to overflow on September 8th.

Birmingham.—No works of importance as far as water supply was concerned were carried out or put in hand by the City of Birmingham during the past year, but work was continued on the important Birmingham, Meriden, and Solihull Joint sewerage scheme. These sewerage works are designed to deal with the drainage from some 15,000 acres, 5014 acres of which lie within the City of Birmingham and the remainder within the adjacent districts of Meriden and Solihull. The Main Valley sewer has a length of 12,500 yards and varies in diameter from 66in. to 33in. The work is being carried out as an unemployment relief works and the first contract, which includes the construction of the Main Valley sewer from the site of the disposal works near Coleshill to Marston Green, a length of 7500 yards, is approaching completion. The second contract, which comprises the construction of a reinforced concrete aqueduct, 366 yards in length, together with a cast iron syphon under the river Cole, is well in hand, and the final and third contract has just been commenced. The latter section of the work includes the construction of the remaining length of the Main Valley sewer and the various branch sewers, a total length of 14,630 yards of sewers.

The Perry Barr sewerage scheme was completed during the year.

Another interesting improvement now being carried out is that of the rivers Tame and Rea to relieve the flooding that occurs periodically along the margins of these rivers. Work was commenced on this scheme in 1930, and steady progress has been maintained. The first two contracts for the lengths between Sweetmoor Bridge and Curdworth Bridge, Coleshill, and from Parkhall Farm Bridge to Bromford-lane, having a length of 4¾ miles, have been practically completed. These sections of the river have been widened to 75ft., the banks sloped to an angle of 45 deg., and revetted with lump slag bedded in concrete. Flood banks have been constructed to prevent the flooding of adjacent lands during periods of maximum discharge. Where the river runs between the Birmingham Racecourse and the London, Midland and Scottish Railway Company's line at Bromford, owing to a restriction of the width available for the improvement of the river, it has for a length of 1¼ miles been widened to 70ft., and contained within brick and concrete retaining walls. A third contract for the length of the river between Bromford-lane and junction of the river Rea has recently been let, and in connection with this section of the work the water rights of the Bromford Mills have been acquired. This length will be improved on the same lines as the previous sections, brick and concrete retaining walls being used where the available width is restricted.

Bradford.—Improvement work was continued during the year on the Esholt Sewage Disposal Works of the Bradford Corporation, a full description of which was given in THE ENGINEER during the year. In June the Ministry of Health sanctioned a loan of £18,776 for the construction of works to connect the sewage from the Thackley area in the city and from the Baildon Urban District to the Esholt works, and this scheme is now in course of construction.

The city is very fortunate in the extent of its water supply and no works of any magnitude were carried out. Late in December, however, the question of the possibility of a water grid was being discussed. Bradford, with its large water reserves, it is thought, might be able to afford a supply to other places, notably to the East Riding, which has made inquiries relating to a supply of 5,000,000 gallons a day. According to the Bradford Waterworks Engineer, the city has to let 11,000,000 gallons run to waste every day. The Chairman of the Water Committee, it is stated, has outlined a grid scheme whereby a 27in. diameter pipe line 50 miles long would connect the Nidd aqueduct with a service reservoir of 20 million gallons capacity on Garrowby Hill to supply Malton, Driffield, Beverly, Market Weighton, Stamford Bridge, and numerous villages. The expenditure on such a scheme, it is estimated, would be about £430,000.

Coventry.—On Thursday, September 29th, the Finham sewage disposal scheme of the city of Coventry was inaugurated by the Mayor, Alderman Vincent Wyles. This scheme was carried out at a cost of £180,000. The new gravitation outfall sewer is egg-shaped, varying in height from 4ft. to 7ft. 6in. and in width from 2ft. 8in. to 5ft. It connects Whitley pumping station with Finham, 2¾ miles away, and is the first part of a larger gravitation scheme. The Finham works are capable of treating a dry weather flow of 3 million gallons, or about one-half of the present sewage flow, the remainder of which is treated at Baginton. Screening and detritus tanks with a capacity of 47,000 gallons and sedimentation tanks with a capacity of 2 million gallons have been constructed, and there are eighteen bacteria beds and humus tanks with a capacity of 375,000 gallons.

Hull.—In August we were able to announce that the City Council of Hull, which has been seeking a new source of supply for some time, had resolved to apply for parliamentary sanction for a great scheme of waterworks extension. According to the proposal, the Farndale Valley in North Yorkshire, about 50 miles from Hull, would be acquired and a reservoir capable of storing 6000 million gallons of water would be constructed there. Such a reservoir, it is believed, would be the second largest in this country. It would be 2 miles long and ½ mile wide, the greatest depth being 110ft., and would provide Hull with an additional supply equal to about 16,000,000 gallons daily, more than doubling the resources of the city. The estimated cost of the scheme is between 1¼ and 1¾ millions, and it would ensure that the requirements of Hull would be met for at least 100 years. According to gelogical experts the strata forming the site of the proposed reservoir consist entirely of the shales of the lower lias series, one of the most impervious geological formations in the country.

Ipswich.—New sewage disposal works at Ipswich were officially opened by the Mayor, Alderman R. F. Jackson, on December 7th. The arrangements for dealing with the sewage of the town before the new works were put in hand could only be regarded as unsatisfactory. Besides providing detritus and sedimentation tanks and more adequate means of dealing with the collected sewage, a new high-level main sewer has been constructed. The old sewer discharged into the river well below high water mark, and at high tide the sewage accumulated in the sewer, with the result that flooding occurred in times of storm and the conditions favoured silting up of the solid matter. The new high-level sewer will relieve the older one of about two-thirds of the dry weather flow and will provide for the development of the town for eighty years. The total cost of the scheme will be £141,000, of which more than £125,000 has already been expended.

Newport.—On July 28th the Mayor cut the first sod for the reservoir dam for Newport's new waterworks undertaking at Talybont. The reservoir is 36 miles from the town in the Glyn Collwyn Valley, and the water to be impounded comes from the river Caerfanell. The length of the reservoir will be nearly 2 miles, its greatest width 500 yards, and its capacity 2500 million gallons. The dam will be about 460 yards long. The engineers to the undertaking are W. E. Lloyd, the Borough and Water Engineer, and Mr. F. W. Macaulay.

Sheffield.—During the year 1932 the large bio-aeration plant at the main sewage works was completed. The plant comprises twenty-two units, each capable of dealing with one million gallons of the dry weather flow and the proper quota of storm water. The whole of the sewage, together with trade wastes and the appropriate volume of storm water from 510,000 persons, is now treated by the new plant. The results obtained have been excellent. Large volumes of the purified effluent are chlorinated and used for condensing purposes by the electricity power station which adjoins the sewage disposal works. Seven large sedimentation tanks have been converted into sludge digestion tanks and the whole of the sludge is now being digested before application to drying areas. About 12 acres of sludge drying areas with pumps, mains, &c., have been laid out at a cost of £50,000 and have now been brought into operation. A new disposal works on the bio-aeration principle is under construction at Woodhouse Mill to purify the sewage in certain areas of the city which cannot be drained to the main works. This plant will provide for a daily dry weather flow of 500,000 gallons. Several new features have been introduced. The sewage will be circulated by two low-lift pumps of the axial flow type. A fall on the circulating channels will allow the sewage to pass along the aerating channels by gravity from the high level to a lower one. At the low point the pumps will lift the liquid to the high level again. Suitable aerating baffles will be provided as required. This plant also includes a sludge digestion tank specially designed with hoppers in the bottom for this purpose. Inlet and outlet pipes are arranged to afford the necessary circulation of the sludge. It is estimated to cost £36,000, exclusive of lands.

Foreign Undertakings.

America.—A considerable amount of work on water supply and sanitary engineering schemes was continued during the year. Perhaps the two most notable schemes are both America. A new water supply tunnel is being driven beneath New York City, as described and illustrated in our columns on October 7th and the following issues, while the Hoover Dam project (THE ENGINEER, December 9th, 1932) while principally a water power scheme, will also serve for water supply.

China.—For a number of years Hong Kong has found it almost impossible to keep pace with the rapidity of growth of demand for water, and the Government decided this year to construct an impounding reservoir on the mainland to hold about 3000 million gallons. This reservoir will be formed by an arched concrete dam some 225ft. in height and by subsidiary dams. Construction has started and the work will be carried out by administration under the direction of Sir Alex. Binnie, Son and Deacon.

Egypt and the Soudan.—Very good progress was maintained during the year on the masonry and iron-work in connection with the second heightening of the Aswan Dam. In the past twelve months about 250,000 cubic metres of masonry were built into the dam and the locks. It is anticipated that the dam and locks, with all the works appertaining thereto, will be completed towards the end of the summer and a few months within the contract period for completion.

France.—The programme for ensuring a satisfactory water supply in all the communes throughout the country with the aid of State subsidies and loans wa continued during the year with slower progress, on account of the smallness of the funds available; but as the Government's plan of public works provides for a large expenditure for this purpose, it is probable that considerably more work will be done in the coming twelvemonth. At present only a quarter of the total number of communes have a water supply. It will therefore take some years before they are all safe from periodical droughts and possible contagion. In the towns, Paris has adopted at the Saint-Maur works the Bunau-Varilla method of sterilising river water with minute doses of chloride so that even the unfiltered water used for city services will offer no danger. In principle, the scheme for supplying Paris with a million cubic metres of water a day from the Vals de Loire is free for execution now that parliamentary sanction has over-ruled local opposition, but no work has yet been started on this important undertaking. Meanwhile the Paris municipality is still interested in the reservoirs which are to regulate the Seine and at the same time supply water for the city's requirements. Two of the reservoirs have been recently completed. Underground supplies are receiving more attention, and Tours has just started pumping from six wells, 5ft. in diameter, that have been sunk in an island in the river Loire. There are four pumps, each driven by internal combustion engines of 150 horse-power, and delivery is at the rate of 1400 cubic metres an hour. As the water is raised from a fine sandy bed, and precautions have had to be taken to prevent sand from entering the pumps, the successful working of the Tours installation is interesting as showing that the supply to Paris from the Vals de Loire, where the conditions are similar, is quite feasible. In the same way, Nice proposes to raise water from beneath the valley of the Var. At present the river water is treated by ozone, a process that has not undergone any great extension on account mainly of the cost; but an ozone plant has been recently installed for sterilising the water supply at Nancy. Other works are being undertaken on the Riviera for bringing water from the valleys of the Lower Alps. The carrying out of works for sewage disposal during the year was hampered by the financial stringency and the failure of the Government to provide funds for public undertakings which include municipal plans of that kind. Most of the schemes for sanitary installations had to be postponed. Yet there was some activity, notably in Paris, where extensions to the Clichy sewage works were started, and an additional pumping plant is being installed for discharging sewage to the farm at Achères. Preparations have been made for new farms beyond Achères, despite local opposition. The works at Colombes are also being enlarged, and all existing plants will have to be increased now that the scheme for collecting and distributing sewage by means of one great system appears to be held up for an indefinite period. There are some new plans that are likely to be put in hand almost immediately, such as the one at Nice, where the sewage must go into the sea under conditions that will not cause inconvenience. The sewage and used water will be decanted and the sludge subjected to the oxidising action of sea water, after which it will be discharged into the sea by pumps with rotors that will reduce solid matter to the required fineness. At Belfort the municipality has approved of a contract with the Société Alsthom and the Compagnie Générale de Constructions de Fours for the installation of a refuse incineration plant with Woodall-Duckham furnaces on the lines of similar plants in some towns in England. The objection on sanitary grounds to a preliminary sorting of refuse was the main reason for the selection of the system. With high-temperature furnaces the whole of the refuse is burnt and, while producing more electrical energy, the slag is of greater value for industrial purposes. The Health Department is particularly anxious to turn the attention of manufacturers to the designing of plants for refuse disposal suitable for small towns. The tests of such plants have been carried out, and awards were made to three competitors. The work of the past year was largely of a preparatory character, and as there seems to be no doubt that the Government will complete its arrangements for giving financial aid to municipal enterprises, as well as to other works, there is every promise of the coming twelvemonth revealing more activity.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

The Outlook for 1933.

THE Midland and Staffordshire industrial area, thanks to the variety of its industries and trades, and to the adaptability and enterprise of its manufacturers, enters upon the year 1933 with better prospects than those held by many other districts. If, as is the case, the heavy engineering trades are still dull and the outlook for them obscure, there is an improvement and brighter hopes for the iron and steel industry, while quite a number of the lighter trades of the district are even to-day busy. What is more, many of them have definite reasons for anticipating a far better trading year than the one just completed. While there are, however, a number of bright features in the local situation, it must not be assumed that anything in the nature of a trade "boom" is in prospect or even that a substantial revival in the course of a month or so is anticipated. What actually is the case is that the auguries for the year are good—decidedly better than they were at this time last year—and there are evidences that as the year advances trade will make progress and things generally will become brighter. Difficulties and disappointments are sure to be encountered. Industrialists also realise that improvement will be but slow, and the fight for trade hard, but there is a quiet optimism and a determination which justifies belief in the ultimate outcome. There is no premature jubilation and no expectation of a sudden return of prosperity, but after a general survey of the conditions existing, Midland manufacturers are satisfied that there is sound reason to hope, as Mr. Baldwin suggests, that in the coming year we shall take "a long stride towards better things." They are assisted to be distinctly hopeful by the fact—of great importance to the Midlands—that the end of the year 1932 was marked by improvement in the iron and steel, coal, automobile, general engineering and a number of manufacturing trades. The protection given to home industries should ensure a larger share of our own market than we had last year. The success of the Ottawa Conference opens up great possibilities, and it is confidently believed that the closer relations established throughout the Empire will have far-reaching results. The present policy of cheap money should go a long way towards assisting in the promotion of new enterprises, and may result in releasing schemes which have been held up in some instances for years. Another favourable feature in the position is that there appears to be a better understanding between employer and workman, and indeed between all classes of the community, and it is recognised that, given united effort, industrial recovery sooner or later is certain. There is therefore in this area as the New Year opens, a hopeful and confident tone, a belief in future prosperity and a will to work for it. Already the spirit which makes for success is operative, and work has begun with the expressed determination on all hands to utilise every legitimate means to achieve success in 1933.

Birmingham Expectations.

In Birmingham itself there is a special feeling of hope for a revival in trade. This is founded upon the intimation by the Lord Mayor (Councillor H. E. Goodby) that within the course of a few days he will announce details of a scheme for the development and assistance of trade and industry in Birmingham. Preliminary consideration has been given to various schemes, but the exact form which the general scheme will take is at the time of writing the subject of close consideration between the Lord Mayor and the city's trading and industrial interests. "It is inevitable," Councillor Goodby says, "that schemes of the magnitude I have in view will need a good deal of preliminary consideration and arrangement, but I am hopeful that I will be enabled to advance certain concrete proposals within the next few days. It is my intention first to seek the whole-hearted support of the citizens of Birmingham to ensure the success of the schemes." The announcement has inspired hope and confidence, and all in the city is eagerly awaiting details of the plan.

The Engineering Trade.

Economic conditions remain against enterprises in which the resources of civil engineering and affiliated branches of structural and mechanical engineering could be employed. Nevertheless, the reduced value of money is suggesting the re-examination of many schemes which have been shelved for varying lengths of time. It is thought probable that in the near future freer scope may be given to progress in this important branch of industry. Electrical engineers have gone ahead during the past year, and there is every indication of further advancement during the year now current. It is somewhat remarkable that though industrial expansion has been arrested, the electrification of industry has gone forward. In Birmingham factories the consumption of electrical energy has increased, and there can be no doubt but that when trade definitely revives, business in generating plant, transmission equipment, technical apparatus and fittings will further expand. In the lighter side of electrical engineering, the outlook remains favourable to further expansion. Automobile engineers throughout the Midlands believe that they will have renewed prosperity during the year. Locally made cars have more than held their own in both the home and overseas markets, and the demand for this season's models is providing work at high pressure in certain establishments. Improved markets overseas include several within the Empire. Firms producing heavy vehicles have had a lean time, but, even here, the position is not without hopeful aspects.

Iron and Steel.

The important improvement in the iron and steel industry in the final months of last year shows signs of being maintained, and even growing stronger, as the first week of the New Year draws to a close. Confidence in the future is such that demand for raw materials is decidedly on the increase, and consumers in this area speak of freer buying in the near future. The industry is in a much better position to meet the year's problems than it was twelve months ago. Foreign competitors now know that they will no longer be permitted to dump material into this country at less than production costs, and native iron and steel masters realise that they have the opportunity of securing for themselves business which up to now has gone to their foreign rivals. Every effort is sure to be made to consolidate the ground and to bring the industry to that state of perfection demanded by the Government in return for the protection afforded. In both the finished and the half-products departments of the steel trade, satisfactory and increased business has been secured of late, but the position has become complicated again by the renewal of fierce competition from the Continent. The foreigner is evidently not satisfied that to maintain a footing in the British market is now nothing short of ruinous to him. It is felt here that the struggle will have to be given up sooner or later, but, nevertheless, speculation as to what developments may be in store this year is rife in Midland iron and steel circles. Confidence in the future is expressed by local millowners, but those producing iron are less prone to optimism than those in the steel section.

Staffordshire Trades.

A number of Staffordshire trades look forward to improved conditions during 1933. Amongst them are the chain and anchor and the nut and bolt industries, both of which anticipate increased orders from shipbuilders. Hopes of a restart on the building of the giant Cunard liner have not been abandoned here. The heavy edge tool trade, which has had a lean time, is now a little better employed, but credit restrictions abroad still militate against any marked recovery in this branch. The tube trade is also doing slightly better. The important contract for the oil pipe line in Irak will provide work for one firm for some time to come. The past year has been an unsatisfactory one for the drop forging industry. It is now maintaining a steady level of output, but prices are down to a low scale. Foundries producing a wide range of light castings are reasonably brisk, and have encouraging prospects. The machine tool industry in Birmingham and Coventry continues to play its part in replacing various types of machine tools and other industrial equipment, much of which, until recently, was obtained from abroad. Further headway should be made during the next twelve months. The hardware and hollowware trades are working on a wider basis, owing to the fiscal changes, and the outlook is reasonably good. New lines of manufacture are being exploited under the shelter afforded the industry in the home market, and goods formerly the monopoly of the foreigner are being produced in increasing quantities in this area, many under special licence or by arrangement with the holders of the patent rights. Staffordshire hands are being employed in production and distribution, and anticipations for the New Year encourage an optimistic outlook.

Market Activity.

The Birmingham iron and steel market is more or less marking time until the quarterly meeting, which is due to be held next week. On 'Change this week there has been a fair amount of general activity, but consumers of iron and steel made only small purchases of material sufficient to carry them on for the time being. Makers have some good contracts on their books, and specifications against them were up to expectations. There was no apparent change in the volume of consumptive demand, and selling prices were quotably unchanged. The Central Pig Iron Producers' Association has reaffirmed the basis prices of Midland grades of forge and foundry iron. Recently steel values were reviewed and maintained, while sheet prices have been reconsidered, and, as previously reported, increased. While therefore considerable movement is expected in trade circles next week, the chances of any revision of selling prices are very remote. Finished iron values, which are not subject to any controlling authority, are unlikely to move either upward or downward. The meeting, however, should afford some guidance as to the probabilities of demand during the current quarter.

Obituary.

The death occurred on December 27th of Mr. John Jenks, of the Cleveland Ironworks, Wolverhampton. The deceased gentleman, who was in his seventy-eighth year, was a director of Jenks Brothers, Ltd., and of the British Tool and Engineering Company, Ltd., Wolverhampton.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Manchester Ship Canal Developments.

OF two important development works on the Manchester Ship Canal which were begun in 1931, one—the construction of a new wharf and lay-bye at Irlam, adjoining the plant of the Lancashire Steel Corporation, Ltd.—has now been completed, and the other—the new oil dock at Stanlow, at the western end of the canal, and about 4½ miles above its entrance at Eastham—will be opened in the present year. The wharf and lay-bye at Irlam have been provided for the handling of ore and mineral traffic. The lay-bye is equipped with the newest type of mechanical unloaders, which are said to be the largest of their kind in the country. It is also equipped with an ore bridge, having a span of 200ft., designed for rapid handling. The wharf is approximately 600ft. in length, and the depth of water alongside is in the region of 28ft.

The Stanlow Oil Dock.

Since the opening of the original oil dock at Stanlow in 1922, the development of the traffic in petroleum spirit has grown until the port of Manchester has become the second most important centre in the country for the importation and storage of petroleum spirit. The oil companies' installations have a total storage capacity of 70,000,000 gallons, and are grouped on the south bank of the canal, while the docks, one in being and the other nearing completion, lie on isolated territory on the north of the waterway. Tankers are discharged by means of pipes running in a subway beneath the canal, a pipe manifold on the south side permitting the delivery of spirit to individual installations. The original dock embodies many fire precaution devices, including a floating boom, which encloses the dock while the vessels within are being discharged. Similar precautions are being applied to the new works. The second dock lies alongside the original dock at an oblique angle to the line of the canal. The widened entrance serving both docks will form a turning basin for the increasing number of vessels using this section of the canal. The new dock, which is 650ft. long and 180ft. wide, with 30ft. depth of water, will accommodate two large ocean-going oil tankers.

Maintenance and Repair Work.

Throughout the past year, the normal programme of maintenance and repair work on the Manchester Ship Canal, including the reconditioning of sluices and floodgates at Barton and Latchford, has been carried out. The bridge over the London, Midland and Scottish Railway Company's line at New Barns has been reconstructed, and the railway bridge connecting the Manchester Docks with Trafford Park and the Northwich-road swingbridge have been reconditioned. Dredging and maintenance of the waterway during 1932 and the upkeep of the Manchester Ship Canal Company's plant and equipment along its 35 miles embraced engineering work ranging over a wide field.

Non-ferrous Metals.

For the second successive week business in the non-ferrous metals has been seriously curtailed in consequence of the holidays, and the turnover in all descriptions has been small. A certain amount of speculative buying interest in copper at one time had a firming influence on prices and an upward movement set in. The advance, however, was not maintained and values reacted. Quotations for standard brands at the moment of writing are a little above the lowest points touched, although not greatly changed on balance compared with a week ago. Trading in the tin section has been very limited and the price tendency has been easy at times. Towards the end of last week, however, quotations became appreciably firmer, but only to react later. The resumption of business on Tuesday of the present week witnessed renewed easiness and prices were forced to lower levels than were current a week ago. Lead has been quiet and featureless, with only minor price changes on balance to record. Spelter, however, after its spell of persistent firmness, has given way to the extent of about 5s. per ton under the influence of selling operations.

Iron and Steel.

A resumption of business on the iron and stee markets this week has been accompanied by a somewhat more cheerful tone. Up to the present, however, actual trading has been quiet, and it will probably not be until towards the end of the month that it will be possible to tell whether the brighter feeling is based upon anything very substantial. In the meantime, deliveries of foundry iron have been resumed on much the same scale as before the holiday break. New business in this section, however, is limited to small parcels, with contract buying a missing feature. Prices are maintained at 67s. per ton for Derbyshire and Staffordshire descriptions, 65s. 6d. for Northants, 62s. for Derbyshire forge, about 82s. for Scottish No. 3, and 81s. for West Coast hematite, all delivered to works in the Manchester district. Business in bar iron is on a retail scale, with quotations at £9 15s. per ton for Lancashire Crown bars, and £10 5s. for best bars. Stuctural firms in the district are understood to be dealing with a seasonall, expanded volume of inquiry in connection with schemes which are projected during the next few months. In most other respects the steel trade is quiet at the moment. A feature of the market for imported materials is the substantial decline in quotations for deliveries into this area of finished products. Inquiry, however, continues very slow.

BARROW-IN-FURNESS.

The Outlook.

A healthier tone certainly exists in this district, which seems to have been born of greater confidence. There were even rumours last week of another furnace going into blast, but this was not confirmed when inquiries were made. Still, makers look forward to better trade this year, and this feeling must be based on some sign or other. The home demand for pig iron is slightly better, and stocks are coming down at some works. At others, the output is practically taken either by buyers or the steel departments. Business with the Continent is inclined to improve a little, and this may be the first sign of recovery. American business has not developed yet, but may do so in the early future with the pound standing where it does. The local iron ore mines are a little better circumstanced as regards business, but in some cases this has not much effect upon employment, as large stocks of ore exist on the surface. Foreign ore is in steady demand, but the shipments are not heavy as yet, nor are they likely to be until more furnaces are put in. The steel trade is still quiet, but here, again, there seems to be more optimism. Last year was not good for the rail mills on the whole, but it is hoped the demand will increase. The hoop mills have benefited by the pound sterling for markets have been regained despite tariffs. As regards shipbuilding and engineering, the position in Barrow is admittedly much better than in many other districts

engaged upon similar work. The contracts held for ships is mostly on naval account—British, Portuguese and Brazilian—and further orders are expected within the next few months. As regards engineering, the town is fortunate, and in some departments there is work for the next eighteen months. As evidence of the urgency of some of the contracts held by Vickers-Armstrongs only two days holiday was given this Christmas, and although New Year's day was observed as a tradesman's holiday in the town, the Naval Construction Works were in full swing. For one thing, the "Bermuda Queen" has to be finished in a month or two, but, apart from that, other work in hand required concentration. Barrow and district thinks the worst is over.

SHEFFIELD.

(From our own Correspondent.)

Optimism Persists.

DESPITE the fact that most of the local steel works are at present far from busy, optimism as regards the future persists in Sheffield industrial circles. Orders have declined substantially during the past few weeks, and most firms have started the New Year with less work in hand then they have had during the past few months. But there are real grounds for believing that this decline is due entirely to the holidays, and that when their influence is finished, trade in Sheffield will resume the improved position noted towards the end of last year. Indications are not lacking of a steadily increasing call for a good many of Sheffield's products during the coming months.

Naval Work Expected.

It is reported that the contracts involved in the delayed 1932 British naval programme will be allotted very soon, and Sheffield expects to get nearly all the work that will have to be done outside the shipyards. This work will include the making of guns and shields, projectiles and armour, many tools and furnishings, and ship cutlery. Other contracts booked by shipyards account for a better demand for high-priced steels and products.

Scunthorpe Position.

As in Sheffield, there has been a temporary decline in trade for the steel works in the Scunthorpe district. Here, again, it is expected that the steady improvement experienced recently by the Normanby Park Iron and Steel Works of Lysaght, Ltd., and at the local branch of Firth-Brown's, the famous Sheffield firm, will soon be renewed. At the works of the Appleby Iron Company (a unit of the United Steel Companies, Ltd.), one of two blast-furnaces was damped down a month ago, but an idle one is being prepared for starting in the course of a few weeks. Three out of five blast-furnaces are working at present at the Normanby Park Works, and the resumption of any additional furnace is dependent on the state of trade. At the steel foundry at Firth-Brown's, Scunthorpe, a satisfactory output of fine steel castings is being maintained.

Work for Russia.

At the Sheffield works of Davy Brothers, Ltd., work in hand includes a large installation to the order of the Russian Government for the production of solid railway wheels, including a number of large hydraulic presses and a patent wheel rolling mill. The same firm recently completed for the Russian Government a large order consisting of electrically operated manipulators for use with high-speed forging presses. The machines delivered comprised one 10-ton, one 3-ton, and four 3-ton manipulators, and one 5-ton charging machine. Other work at present being done by this firm includes a large Morgan continuous rolling mill plant for one of the leading British steel works.

New Melting Department.

It is stated officially that by the Spring of this year the new Siemens melting department of the English Steel Corporation, Ltd., Sheffield, will be in operation. This department comprises new Siemens furnaces of the most modern automatically controlled type, gas machines complete with coal and ash-handling plant, and adequate crane facilities for handling ingots up to a weight of 250 to 300 tons. It will be the most up-to-date Siemens melting plant in the country for the class of work produced by this firm. Work has been commenced also on the rebuilding and re-equipment of the forge department, comprising new buildings, and the concentration, in one department, of the principal forging plants of the various branches. The corporation booked considerable orders during October and November for heavy forgings, and it is expected that these will keep the forge occupied to a considerable extent for some time to come.

Steel Bridges.

Several contracts for steel bridges for carrying both railways and roads, have been carried out recently by Newton, Chambers and Co., Ltd., of the Thorncliffe Ironworks, near Sheffield. This firm is at present erecting a bridge of this kind for the West Riding County Council at Thorne, and have just secured another order for a big road bridge for the same authority.

Rolling Mill Contracts.

Several rolling mills made by the Brightside Foundry and Engineering Company, Ltd., Sheffield, and installed in works in this country a few years ago, have been shipped abroad, and this movement has resulted in substantial orders for rolls which will be required when the mills are in operation at their new destination. The contracts now in progress at this firm's works also include two 30-ton hot drawbenches for the Continental market, a complete sheet lead rolling plant for a prominent home producer, a four high cold rolling mill for brass and copper strip, and a Lauth type sheet rolling mill for copper for the Far East. In addition, there is also on order complete hot and cold rolling mill plant for aluminium strip and a 300 H.P. drive for a Sheffield sheet rolling mill.

Cutlery and Plate.

As is usual at this period of the year, the Sheffield works which make ordinary lines of cutlery and various qualities of plated ware are doing very little. The prospects for high-quality plate are not good, but chromium plating continues to make progress. Manufacturers of scissors are busy, and the substantial output of safety razors and blades is being maintained.

Land Drainage Works.

The engineer of the River Ouse Catchment Board has reported on obstructions to the river Dearne at Bolton Mill and at Five Arches Bridge, and on the river Rother at Chesterfield, but the decision has been made to adjourn consideration of the question of carrying out works of improvement in view of the possibility that any such works at the present time would increase the liability to flooding of the Doncaster district. Maintenance works are now being carried out by the Board on 350 miles of main river banks on which seventeen gangs of labourers are employed. There are 500 miles of main river under the control of the Board.

Regional Water Scheme.

The consulting engineers of the Scunthorpe and Frodingham Urban District Council, the Brigg Urban District Council, and the Glanford-Brigg Rural Council have prepared a report containing details of three alternative schemes for a regional water supply. A small committee, consisting of two representatives of each of the three authorities, has been composed to devise a scheme acceptable to all parties.

NORTH OF ENGLAND.

(From our own Correspondent.)

A Better Trade Outlook.

AFTER another year of acute depression, the North of England is hopeful that the worst is over, and that the next twelve months will see the dawn of a brighter and more prosperous state of affairs in industry generally. How far that hope will materialise is difficult to say at the moment, but there is a feeling that a gradual revival will not long be delayed. The coal trade has already made great headway, and the outlook for the first quarter at least is particularly bright. Shipbuilding and marine engineering has been very hard hit, and with so much idle tonnage still to be absorbed, it would be futile to anticipate any big activity in the shipbuilding line. In the last two or three weeks, however, a number of inquiries for new tonnage have been circulating, and if no new orders have been placed, it may be taken that there is still hope. Certain moves are being made with a view to scrapping old and obsolete tonnage, and replacing it with new and up-to-date vessels. This scheme is being watched with interest by the builders, for should it be put into practice, it will provide a fair amount of work and help to relieve the present stagnation. Electrical engineering is one of the brightest spots in Northern industry. Large orders in connection with the National Grid Scheme locally have been followed by others from distant parts, and will almost surely bring a great deal of more business in the next twelve months. An increasing demand is being experienced for small industrial turbines of the self-contained type, for which no basement is needed. These machines are very popular in India and the Far East, where low first cost and safety when operated by a native or unskilled labour are both essential. Optimism as regards a revival in the iron and steel industries is based on more solid grounds than a year ago, and there are good indications which justify the belief that this year will turn out much better than the last few years. Mr. Charles Mitchell, the chairman of Dorman, Long and Co., Ltd., Middlesbrough, is very hopeful regarding the prospects. He says: "The full benefit of the tariff on imported steel has not yet been felt, in the main because the Continent was not at first convinced, owing to the temporary nature of the first import duty orders, that Great Britain really intended to supply her requirements from within her own industry. Now, however, the tariff is becoming increasingly effective, and is enabling British steel makers to tackle their domestic problem in a way that has not hitherto been possible. Continental prices have risen to such an extent that in many products they are no longer competitive with British steel, and this movement I regard as of valuable augury for rather better tonnages in 1933."

Iron and Steel Exports.

Notwithstanding reduced shipments coastwise, the total clearances of iron and steel from the Tees in December show slight increase as compared with November, the respective tonnages being 35,585 and 34,892. The improvement in the foreign shipments embraces both pig iron and foreign material. Denmark was the largest foreign customer for pig iron, with 1753 tons. Russia was the biggest buyer of finished material, with 3576 tons; while South Africa took 3305 tons and India 1670 tons. In spite of the immense trading difficulties of the past year, it is satisfactory to find that the exports of iron and steel from the Teesside district fell by only 100,000 tons, as compared with the total for 1931. Pig iron shipments were reduced by about 20,000 tons, although coastwise clearances were rather higher, and a decline of about 80,000 tons in the exports of manufactured iron and steel is chiefly due to a contraction of about 50 per cent. in the African trade, and of about 30 per cent. in the shipments to India. South America has taken more steel from Teesside, and so, too, has China; whilst shipments of over 30,000 tons of finished material to Russia represents a new trade. On the other hand, less steel was shipped to the United States and Canada, although in this direction there is every prospect of a marked improvement in the future. Indeed, in every section of the iron and steel trade producers are looking forward to much greater activity on export account. New preferences have been accorded in certain markets, more particularly in Canada, India, and Australia, and manufacturers expect a marked expansion of trade with these great markets. The home trade also promises better things. With the operation of the import duties, the locally produced materials are now able to hold their own in the home market. Not a ton of foreign material of several types and qualities has been sold on Teesside for months. As a result, there is a lowering of stocks, and it is hoped that more producing plant will be needed before long.

Cleveland Iron Trade.

When operations were resumed on the Cleveland pig iron market, holiday influences were still in the ascendancy, and little business was transacted. The situation in the industry, however, was stated to be showing a steady and encouraging improvement. As a result of the blast-furnaces being kept in full operation over the holidays, stocks of iron have increased to some extent, but they will be quickly reduced when the consuming works get into full swing again. A satisfactory feature is the greater inclination of consumers to arrange forward deliveries, and several good contracts have been placed for the next three months. Prices are steadily maintained, No. 1 Cleveland foundry iron being 61s., No. 3 G.M.B. 58s. 6d., No. 4 foundry 57s. 6d., and No. 4 forge 57s.

Hematite Pig Iron.

There is no change of moment in the East Coast hematite pig iron trade. Producers are better situated as regards orders than for some months past, and are anticipating much increased business. Mixed numbers are firm at 59s., with No. 1 quality at a premium of 6d. per ton.

Iron-making Materials.

Dull conditions prevail in the foreign ore trade, and best Rubio is nominal at 15s. c.i.f. Tees. Good medium blast-furnace coke commands 15s. 9d. to 16s., delivered at the works.

Manufactured Iron and Steel.

Business in semi-finished steel is fairly brisk, and a large number of contracts for deliveries over the first quarter of the year are reported. There is not much activity in the finished steel sections, but improved conditions are confidently expected in the near future. Prices are unchanged.

Coal Trade Outlook.

The prospect for the Northern coal trade for 1933 is considerably better than it has been at the beginning of the past two or three years. There is a much improved inquiry and a greater readiness on the part of buyers overseas to negotiate for British coal. Certain Baltic countries are stipulating that pit timber should be purchased in exchange, but that, it is pointed out, is no hardship, as pit timber is required in any case, and a reciprocal arrangement is likely to benefit both parties. Only this week some 30,000 tons of railway coal have been allocated to Durham and Northumberland, in severe competition with the subsidised prices which Poland is able to offer the Baltic countries. There is every reason to hope that this promising feature will be emphasised in the new future. Northumberland is in the happy position of having practically only two grades of coal to dispose of, and good trade seems assured over the next six or nine months at any rate. Durham is not quite so comfortably placed, having so many different grades, such as steam coal, gas and coking coal, and other "made" coal, such as nuts and peas, but there again the promise is much brighter than it has been for the last two or three years. One pleasing feature of the trade is the better demand for bunker coal, and this, of course, indicates a revived shipping business.

The Coal Market.

All the collieries operating before the holidays are again in action, but outputs have not yet assumed recent proportions. Most descriptions of fuel are well sold over the next two months, and it is thought that the recent good inquiry will be maintained. More coke nuts are going to America. After protracted negotiations, a sale of 80,000 tons of coke nuts has been effected for delivery to the Northern Range of the United States over the next twelve months. No price has been divulged, but it is expected that the business has matured on the basis of present prices. Sellers of coke nuts, however, are greatly concerned at the news that the American Attorney-General has stated that the import tax on coke nuts must stand. Steps have been taken to have the matter put before the British Ambassador in Washington and before the Mines Department, and the outcome is anxiously awaited. The tax amounts to over 2 dollars a ton, and must be paid by shippers. The market for Northumberland steam coals remains very firm. Loading turns are difficult to arrange, and only small orders can be placed, for which recent rates are easily obtained. Best qualities are quoted at 14s. 3d. to 14s. 6d., with smalls at 8s. 6d. Tyne primes are steadily quoted at 13s. 3d. to 13s. 6d., with smalls at about 9s. For prime Wear steams the position is unchanged at 16s. Other classes are about 12s. 6d. and smalls 8s. There is a steady demand for Durham gas coals, and best qualities remain unchanged at 14s. 6d. Special Wear gas are about 15s., and other sorts 13s. 3d. to 13s. 6d. Coking coals are firmer with supplies more limited, and 12s. 6d. to 13s. 6d. is easily obtainable, according to make. Bunkers for prompt shipment are firm at 14s. to 14s. 6d. for best and 13s. to 13s. 6d. for others. The gas coke market is firm and unchanged at 18s. 6d. for best makes. Foundry coke

is also maintained at 15s. 6d. to 16s. 6d. The coke nuts position is now under a cloud, and merchants cannot do anything until some definite lead is obtained with regard to the import tax just imposed. Prices are nominally unchanged at 17s. 6d. to 18s. 6d.

SCOTLAND.

(From our own Correspondent.)

New Year Holidays.

MARKETS have been practically idle since Christmas, and will probably remain so for another week at least, owing to the general quietness in industry.

Shipbuilding Orders.

It has been announced that the Burntisland Shipbuilding Company, Ltd., has received an order for two cargo steamers, each of 8500 tons deadweight, from Walter Runciman and Co., Ltd., Newcastle. The propelling machinery will consist of White's patented combination engine, which is based on reciprocating and turbine principles. The Burntisland yard is one of the busiest at present, as, in addition to the vessels being built, seven new vessels have still to be laid down.

Steel and Iron.

Nothing occurred during the closing week of 1932 to alter the outlook in the steel and iron trade. Specifications for heavy steel continued scarce, especially for plates and sections, and there seems no immediate prospect of increasing the production beyond about 40 to 50 per cent. of the normal. The position of thin steel sheets still presents a bright spot. Makers of these goods are comparatively well employed, and the inquiry appears favourable. Heavy black and all descriptions of galvanised sheets are somewhat slow to improve. In the tube trade the hot-rolled section is the only one showing a fair measure of activity. Bar iron and re-rolled steel bars continued to experience a small demand. Re-rolled steel bars were unchanged in price at £7 5s. home and £6 10s. per ton export. At the close of the year the production of pig iron was still confined to two furnaces, and there is no inducement to increase outputs. Demands are easily satisfied from production, and stocks along with continued imports from India and the North-West of England.

Coal.

The coal market was almost at a standstill during the last week of the year. Many qualities of fuel were unobtainable for prompt shipment, and the others only in small lots. The only exception was Lanarkshire smalls. It is understood that the quota production for Scotland for the January–March quarter has been provisionally fixed at 82 per cent. of the standard. The equivalent production is, it is understood, about 7,500,000 tons, compared with approximately 7,910,000 tons allowed during October–December last. The aggregate shipments from Scottish ports during 1932 amounted to 11,844,095 tons, showing an increase of 1,130,000 tons compared with 1931. The increase was largely confined to the East of Scotland, Fifeshire exports being up 500,000 tons and the Lothians to almost a similar amount. Coastwise shipments have been more prominent than usual.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Trade and Prospects.

FOR some years past traders have been inclined to express their relief that the Old Year has gone, and 1932 was no exception, inasmuch as most branches of industry in this area recorded retrogression rather than an improvement. Official figures are not as yet available in regard to the volume of trade at the ports in this area under the control of the Great Western Railway Company, but there can be little doubt that they will eventually show that imports and exports combined were less for 1932, as compared with 1931, by rather more than 1¼ million tons. Of course, the decline in the coal and coke export trade is chiefly responsible for this falling off, as shipments of coal and coke will in all probability be found to be less by round about 1¼ million tons. It is possible that the output during the past year of pig iron and crude steel will prove to be higher than the total for 1931, but in the case of ship-repairing it is very doubtful whether employers were as actively employed as during 1931. While, however, at the moment trade conditions generally are quiet, there are indications on all hands of confidence that 1933 will turn out to be a better year for practically all sections of industry in South Wales. The outlook in the tin-plate trade is regarded as distinctly more hopeful, and works are being restarted, while there is more activity indicated in the iron and steel department. In the ship-repairing industry there is definite reason for looking for some improvement as before the Old Year terminated employers and representatives of all trade unions came to an agreement revising the working conditions to apply in this channel, as from the beginning of this month. For some time during 1931 representatives of both sides had been carrying on negotiations with a view to coming to terms in order to enable the employers to meet the competition of other districts, and fortunately these negotiations were brought to a successful end with the utmost good feeling prevailing between the two parties. Full details of the agreement have not been divulged, though it is reported that in the case of a number of sections of workmen the terms provide for a 20 per cent. reduction in tariff rates. It is to be hoped that as the result of the agreement, additional work will be secured for South Wales, such as will compensate the workmen for the sacrifice which they have made in their conditions, and that more regular employment will be experienced in the future. Confidence prevails that the current year will see some recovery in the coal trade. Certainly on the anthracite side the prospects are brighter. Even during the past year it is satisfactory to record that shipments to Canada topped well over 1,000,000 tons, and this trade is expected to enjoy further expansion. On the steam coal side the outlook may not be quite so definite, but the utmost is being done to extend operations. One new outlet has already been recorded, viz., the shipment of 50,000 tons of locomotive coals to the Newfoundland National Railways in exchange for nearly 100,000 tons of pit-props. Shipments will be made between May and September next, and in this connection it can be stated that Gueret, Llewellyn and Merrett, Ltd., of Cardiff, have arranged for a tonnage cover for the whole business with a British firm, viz., Sir R. Ropner and Co., Ltd. This will enable the latter firm to keep more of its smaller and less economical steamers in employment. Though not officially disclosed, it is reported on the market that the rate of freight for the coal is 6s. and for the pit-props about 8s. per ton. In the case of coals for France, it is understood that the French Government has decided to continue the December import quota for January, but apart from this, it is reported that a move is being made in France for the abolition of the import quota altogether. It is to be hoped that this will come about, as the removal of restrictions and barriers to trade is eminently to be desired.

Coal Items.

Returns of coal and coke shipments last week were reduced, as was expected would be the case, in view of the holidays. The loss of two days' work in the coalfield and at the docks meant that at the ports under the control of the Great Western Railway Company shipments came to only 276,415 tons, which compared with 404,870 tons for the week immediately preceding the Christmas holidays. Since the vacation the tonnage position has, in all the circumstances, been fairly satisfactory. This week opened with the number of idle tipping appliances at the various docks between Newport and Swansea, totalling twenty-two, while at Swansea two steamers were waiting to berth. Business generally has, of course, been quiet, and it will in all probability be next week before anything like settled conditions prevail. The inquiry from all directions at the moment is undoubtedly on the slow side, but is fully expected to improve later. At the time of writing no news has come to hand regarding the placing of the order by the Egyptian State Railways for 60,000 metric tons of locomotive coals for delivery at Alexandria over the next three months, while as regards new business it is reported that the Syrian Railways are likely to require prices shortly for about 30,000 tons of coal for delivery over 1933.

Steel and Tin-plates.

Hopes are entertained that it will not be very long before the Brymbo Steel Works, near Wrexham, which have been closed for about eighteen months, resume operations. An official statement shows, however, that Sir Henry Robertson, who is so largely interested in this undertaking, met recently representatives of the men and discussed with them the possibility, but beyond recording the fact that this meeting had taken place, it was quite premature to say that the works will restart. All concerned are examining the situation closely, in the hope that a satisfactory solution will be found, leading to a resumption of work. Reference was made recently to the steps taken for absorbing unemployed by introducing six-hour shifts in the local tin-plate industry. Since then, however, the employees of the Llanelly group of works of Richard Thomas and Co., Ltd., have declined to adopt the proposal. Their objection to the scheme was that by adopting it the earning capacity of each man would be reduced by 25 per cent. However, it is understood that in the event of the scheme being brought into general operation in the industry the question will be reconsidered by the workmen in the Llanelly area.

The Coal Movement.

The movement for the increased consumption of coal is expected to receive an impetus as the result of an important function to take place at Cardiff on the 20th inst. The director of the Coal Utilisation Council (Mr. W. R. Gordon) makes his first appearance in South Wales on this occasion, and Mr. Evan Williams, President of the Mining Association of Great Britain and Chairman of the South Wales Coal Conciliation Board, will be the chief guest. The Lord Mayor of Cardiff will preside, and the gathering will be representative of the commercial industrial, and political life of this district. Mr. Evan Williams is expected to initiate discussion, in which Mr. Gordon, on behalf of the Coal Utilisation Council, and Mr. Iestyn Williams, on behalf of the Back-to-Coal Movement, will take part.

Coal Contract.

The order for 66,000 metric tons of locomotive coal for the Egyptian State Railways has been placed with T. Beynon and Co., Ltd., of Cardiff, whose price of 24s. 3d. c.i.f. Alexandria was the lowest for Welsh coals.

Steel Works Order.

Whiteheads Iron and Steel Company, Ltd., of Newport, have received a further order from the Soviet Government for 4000 to 5000 tons of tube strip. This firm, which is working full time, received an order for 10,000 tons in May, 1931, from the Soviet Government. There is a prospect of the present order being increased.

Current Business.

Operations on the coal market have scarcely settled down, owing to the holidays, but so far as steam coals are concerned, prices remain without any alteration. Sized coals are firm, but large coals are plentiful. Coke is meeting with an improved demand, and is expected to command an even greater inquiry with extended operations at steel works, tin-plate undertakings, &c. Patent fuel remains steady, but pitwood has become much weaker, owing to supplies having come to hand more freely, while the demand for this commodity keeps on modest lines. Prices are now about 22s. to 22s. 6d.

CALENDARS, DIARIES, &c.

AVONSIDE ENGINE COMPANY, Ltd., Bristol.—Wall calendar.

BRITISH ROLLING MILLS, Ltd., Tipton, Staffs.—Wall calendar.

GEAR GRINDING COMPANY, Ltd., Birmingham.—Wall calendar.

R. AND W. HAWTHORN, LESLIE AND CO., Ltd., Newcastle-upon-Tyne.—Wall calendar.

HOLMAN BROTHERS, Ltd., Camborne, Cornwall.—Wall calendar.

IRONITE COMPANY, Ltd., 11, Old Queen-street, S.W.1.—Wall calendar.

KING'S PATENT AGENCY, Ltd., 146a, Queen Victoria-street, E.C.4.—Desk diary.

LEIPZIG INTERNATIONAL INDUSTRIES FAIR, 1, Gower-street, W.C.1.—Greeting card and desk calendar.

NATIONAL GAS AND OIL ENGINE COMPANY, Ltd., Ashton-under-Lyne.—Wall calendar.

NATIONAL UNION OF COMMERCIAL TRAVELLERS, 24, Thavies-inn, Holborn Viaduct, E.C.1.—Pocket diary, price 1s. 6d.

C. A. PARSONS AND CO., Ltd., Newcastle-upon-Tyne.—Wall calendar.

RANSOMES AND MARLES BEARING COMPANY, Ltd., Newark-on-Trent.—Wall calendar.

REASON MANUFACTURING COMPANY, Ltd., Brighton.—Greeting card.

GEORGE REVEIRS, Ltd., 10–12, Rosebery-avenue, E.C.1.—Pocket diary.

THOMAS ROBINSON AND SON, Ltd., Rochdale.—Wall calendar.

HENRY SIMON, Ltd., Cheadle Heath, Stockport.—Desk calendar.

STANTON IRONWORKS COMPANY, Ltd., near Nottingham.—Diary.

STAVELEY COAL AND IRON COMPANY, Ltd., near Chesterfield.—Diary.

S. S. STOTT AND CO., Laneside Foundry, Haslingden, Rossendale.—Wall calendar.

HERBERT TERRY AND SONS, Ltd., Redditch.—Greeting card.

THAMES BOARD MILLS, Ltd., Purfleet, Essex.—Desk calendar.

WAILES DOVE BITUMASTIC, Ltd., Newcastle-upon-Tyne.—Diary.

EDWARD WOOD AND CO., Ltd., 68, Victoria-street, S.W.—Diary.

WOOLWICH EQUITABLE BUILDING SOCIETY, Bush House, Aldwych, W.C.2.—Wall calendar.

CONTRACTS.

VITREFLEX, Ltd., has secured the contract for roofing the new grand-stand at Kempton Park Racecourse.

JOHN I. THORNYCROFT AND CO., Ltd., report that a well-known Continental yachtsman has just placed with them an order for a twin-screw motor yacht.

MIRRLEES, BICKERTON AND DAY, Ltd., of 7, Grosvenor-gardens, S.W.1, and Stockport, have recently received orders for thirty "Mirrlees-Diesel" and "Mirrlees-Ricardo" engines, having an aggregate horse-power of upwards of 8700, from twenty-four clients in this country and abroad, among whom may be mentioned Barnstaple Corporation, Jersey Electricity Company, Chester Waterworks, Oban Electricity Works, Buckie Corporation, Herne Bay Waterworks, Jackson's Paper Works, Bucks; and clients in India, Africa, Arabia, and Trinidad. Fifteen of the above engines represent repeat orders.

THOMAS PIGGOTT AND CO., Ltd., Birmingham, have received a contract for a Klonne dry gasholder of two million cubic feet capacity from British (Guest Keen Baldwins) Iron and Steel Company, Ltd. The holder will have a diameter of 126ft. and a total height of 206ft., and will be used for the storage of blast-furnace and coke-oven gas in connection with the developments at the Port Talbot and Margam Works. The gasholder will serve as an accumulator and balancer, maintaining constant pressure to the various points of consumption, including the sleeper plant furnace, the plate normalising furnace, the billet heating furnace, and water-tube boilers.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

MR. D. WINTON THORPE, A.M.I.E.E., informs us that he has changed his address to 100, Victoria-street, London, S.W.1. Telephone, Victoria 6436.

ANGLO-HOLLANDIA MACHINERIES, Ltd., inform us that from January 2nd their address will be Dixon House, 1, Lloyd's-avenue, London, E.C.3. Telephone number, Royal 1738.

MR. O. C. DINERMAN has been appointed to represent Laurence, Scott and Electromotors, Ltd., of Norwich and Manchester, for the sale of A.C. and D.C. motors and control gear in Yorkshire. His office is situated at Standard Buildings, City-square, Leeds. Telephone number, Leeds 24605.

AN agreement has been entered into with the New Consolidated Gold Fields, Ltd., to act as managers of the Buell Combustion Company, Ltd., Aldwych House, Aldwych, W.C.2, in so far as the application of the Buell pulverised fuel system to land installations is concerned. The business will be conducted from the new registered offices at 49, Moorgate, E.C.2. Samuel Hodge and Sons, Ltd., who previously held both the land and marine rights of the Buell pulverised fuel system, will now confine their activities so far as this system is concerned to its installation for marine purposes.

"FLOTATION PLANT PRACTICE."—In the review of "Flotation Plant Practice" in our issue of December 30th, the author's name should have been given as Philip Rabone, and not Phillip Rathbone.

THE INSTITUTION OF MECHANICAL ENGINEERS.—Prizes were awarded by the Council for papers read before Graduates Sections of the Institution of Mechanical Engineers during the session 1931–32:—A. R. Clague (student): "The Testing of Turbine Generating Sets" (read at a meeting of the Graduates' Section, North-Western Branch, on November 26th, 1931); R. M. Dymond, B.Sc. (graduate): "Some Considerations Affecting Dock Equipment" (read at a Graduates' and Students' meeting of the South Wales Branch on February 15th, 1932); F. R. Mason (graduate): "Some Considerations of the Economics of Power Generation" (read at a meeting of the Graduates' Section, North-Western Branch, on February 25th, 1932); C. Taylor, M.A. (student): "Textile Machinery" (read at a meeting of the Graduates' Section, North-Western Branch, on March 10th, 1932). Abridgments of the papers by A. R. Clague and R. M. Dymond will be published in the "Proceedings" of the Institution.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
(1) Native	15/6 to 20/–
(1) Spanish	17/– to 24/–
N.E. COAST—	
Native	18/– to 21/–
Foreign (c.i.f.)	15/–

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	3 6 0	—
No. 1 Foundry	3 10 0	—
No. 3 Foundry	3 7 6	—
N.E. COAST—		
Hematite Mixed Nos.	2 19 0	2 19 0
No. 1	2 19 6	2 19 6
Cleveland—		
No. 1	3 1 0	3 1 0
Siliceous Iron	3 1 0	3 1 0
No. 3 G.M.B.	2 18 6	2 18 6
No. 4 Foundry	2 17 6	2 17 6
No. 4 Forge	2 17 0	2 17 0
Mottled	2 16 6	2 16 6
White	2 16 6	2 16 6
MIDLANDS—		
(c) Staffs.—	(*Delivered to Station.*)	
All-mine (Cold-blast)	—	—
North Staffs. Forge	3 1 0	—
" " Foundry	3 6 0	—
(c) Northampton—		
Foundry No. 3	3 2 6	—
Forge	2 17 6	—
(c) Derbyshire—		
No. 3 Foundry	3 6 0	—
Forge	3 1 0	—
(3) Lincolnshire—		
No. 3 Foundry	—	—
No. 4 Forge	—	—
Basic	—	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	3 15 6 (*a*); 4 0 6 (*b*); 4 5 6 (*c*)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	9 15 0	9 5 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 5 0	—
Common Bars	9 5 0	—
Best Bars	10 5 0	—
Double Best Bars	10 15 0	—
Treble Best Bars	11 5 0	—
LANCS.—		
Crown Bars	9 15 0	—
Best Bars	10 5 0	—
Hoops	12 0 0	—
S. YORKS.—		
Crown Bars	9 15 0	—
Best Bars	10 15 0	—
Hoops	12 0 0	—
MIDLANDS—		
Crown Bars	9 0 0 to 9 15 0	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	8 0 0 to 8 10 0	—
Gas Tube Strip	10 7 6 to 10 10 0	—

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates (Marine)	9 0 0	8 10 0
" " (Land)	—	—
Ship Plates, ½in. and up	8 15 0	7 15 0
Sections	8 7 6	7 7 6
Steel Sheets, ¼in.	7 15 0	7 15 0
Sheets (Gal. Cor. 24 B.G.)	11 5 0–10 Ton	10 0 0
	Lots and Upwards Delivered Glasgow Stations.	
" (Gal. Cor. 24 B.G.)	For Canada	10 15 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 15 0	7 15 0
Angles	8 7 6	7 7 6
Boiler Plates (Marine)	10 10 0	—
" " (Land)	10 0 0	—
Joists	8 15 0	7 7 6
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	7 2 6	—
Soft Billets	5 10 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	—
Billets	6 10 0 to 9 0 0	—
MANCHESTER—		
Bars (Round)	9 7 6	—
" (Small Round)	6 15 0	—
Hoops (Baling)	10 0 0	9 15 0
" (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
" (Lancs. Boiler)	8 10 0	—
SHEFFIELD—		
Siemens Acid Billets	9 2 6 (basis)	—
Hard Basic	8 2 6 and 8 12 6	—
Intermediate Basic	6 12 6 and 7 2 6	—
Soft Basic	5 15 0	—
Hoops	9 10 0 to 9 15 0	—
Soft Wire Rods	7 10 0	—
MIDLANDS—		
Small Rolled Bars (all British)	7 0 0 to 7 5 0	—
Small Re-rolled Bars	6 15 0 to 6 17 6	—
Billets and Sheet Bars	4 17 6 to 5 7 6	—
Galv. Sheets	11 15 0 to 13 15 0	10 10 0
(2) Staffordshire Hoops	9 10 0	—
(*d*) Angles	8 7 6	—
(*d*) Joists	8 15 0	—
(*d*) Tees	9 7 6	—
(*d*) Bridge and Tank Plates	8 17 6	—
Boiler Plates	8 7 6 to 8 10 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14 f.o.b.	15/9 to 16/3
Block Tin (cash)	147 17 6
" (three months)	148 15 0
Copper (cash)	28 16 3
" (three months)	29 3 9
Spanish Lead (cash)	10 13 9
" " (three months)	11 0 0
Spelter (cash)	14 18 9
" (three months)	15 2 6
MANCHESTER—	
Copper, Best Selected Ingots	33 5 0
" Electrolytic	34 5 0
" Strong Sheets	65 0 0
" Tubes (Basis Price), lb.	0 0 10
Brass Tubes (Basis Price), lb.	0 0 9
" Condenser, lb.	0 0 11½
Lead, English	12 12 6
" Foreign	11 5 0
Spelter	15 5 0
Aluminium (per ton—raw ingot)	£95

FERRO ALLOYS.

Tungsten Metal Powder	1/10½ per lb.	
Ferro Tungsten	1/7½ per lb.	
	Per Ton.	Per Unit.
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£25 15 0	8/–
" " 6 p.c. to 8 p.c.	£24 10 0	7/6
" " 8 p.c. to 10 p.c.	£22 5 0	7/–
" " Specially Refined		
" " Max. 2 p.c. carbon	£36 10 0	11/–
" " " 1 p.c. carbon	£42 12 0	14/–
" " " 0·70 p.c. carbon	£44 0 0	16/–
" " " carbon free	1/– per lb.	
Metallic Chromium	2/9 per lb.	
Ferro Manganese (per ton)	£10 15 0 for home	
" " "	£9 15 0 for export	
" Silicon, 45 p.c. to 50 p.c.	£13 10 0 scale 5/– per unit	
" " 75 p.c.	£19 10 0 scale 6/– per unit	
" Vanadium	12/6 per lb.	
" Molybdenum	6/3 per lb.	
" Titanium (carbon free)	9d. per lb.	
Nickel (per ton)	£245 0 0	
Ferro Cobalt	7/9 per lb.	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	15/–
" " Ell	16/– to 16/6
" " Splint	16/6 to 17/6
" " Trebles	15/– to 16/–
" " Doubles	12/6 to 13/–
" " Singles	11/6
AYRSHIRE—	
(f.o.b. Ports)—Steam	14/6
" " Jewel	16/6
" " Trebles	15/6 to 16/–
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	13/– to 15/–
Screened Navigation	16/6 to 17/6
Trebles	17/– to 18/6
Doubles	13/6 to 14/6
Singles	11/6 to 12/–
LOTHIANS—	
(f.o.b. Leith)—Best Steam	14/–
Secondary Steam	13/6
Trebles	15/6 to 16/–
Doubles	12/– to 12/6
Singles	11/3 to 11/6

(8) N.W. COAST— ENGLAND.	
Steams	19/– to 23/6
Household	32/6 to 52/6
Coke	18/– to 22/6
NORTHUMBERLAND—	
Best Steams	14/6
Second Steams	12/6 to 12/9
Steam Smalls	8/6
Unscreened	12/6 to 13/–
Household	27/– to 39/–
DURHAM—	
Best Gas	14/6
Second	13/3 to 13/6
Household	25/– to 37/–
Foundry Coke	24/–

SHEFFIELD	Inland.
Best Hand-picked Branch	27/– to 28/–
South Yorkshire Best	23/– to 24/–
South Yorkshire Seconds	18/– to 21/–
Derbyshire Best House	22/– to 23/6
Derbyshire Best Brights	18/– to 20/–
Screened Seconds	17/6 to 19/–
Kitchen Coal	16/6 to 17/6
Best Screened Nuts	17/– to 18/6
Small Screened Nuts	16/– to 16/6
Yorkshire Hards	17/– to 18/–
Derbyshire Hards	17/– to 18/–
Rough Slacks	8/6 to 9/6
Nutty Slacks	7/– to 8/6

Blast-furnace Coke (Inland) 10/– on rail at ovens

Furnace and Foundry Coke (Export), f.o.b., 14/6 to 15/6

(9) SOUTH WALES.

CARDIFF—	
Steam Coals :	
Best Smokeless Large	19/6 to 19/9
Second Smokeless Large	18/9 to 19/6
Best Dry Large	19/– to 19/6
Ordinary Dry Large	17/9 to 18/3
Best Black Vein Large	18/3 to 18/6
Western Valley Large	17/9 to 18/–
Best Eastern Valley Large	17/7½ to 17/9
Ordinary Eastern Valley Large	17/3 to 17/6
Best Steam Smalls	13/– to 13/6
Ordinary Smalls	11/– to 13/–
Washed Nuts	20/– to 32/–
No. 3 Rhondda Large	19/6 to 19/9
" " Smalls	15/– to 16/–
No. 2 " Large	17/– to 17/3
" " Through	15/6 to 16/–
" " Smalls	14/– to 14/3
Foundry Coke (Export)	22/6 to 36/6
Furnace Coke (Export)	17/– to 18/–
Patent Fuel	20/–
Pitwood (ex ship)	22/– to 23/–
SWANSEA—	
Anthracite Coals :	
Best Big Vein Large	36/– to 38/6
Seconds	27/– to 34/–
Red Vein	22/– to 26/6
Machine-made Cobbles	37/6 to 48/6
Nuts	36/6 to 48/6
Beans	28/6 to 32/6
Peas	19/6 to 21/–
Breaker Duff	8/6 to 9/6
Rubbly Culm	8/6 to 9/–
Steam Coals :	
Large	20/– to 20/6
Seconds	18/– to 20/–
Smalls	11/6 to 13/–
Cargo Through	16/– to 17/6

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate : Joists (minimum), 22/6 ; Ordinary Ship, Bridge, and Tank Plates and Sections, 15/–, if home consumers confine purchases from associated British Steel Makers. (*e*) Delivered Black Country Stations.

French Engineering Notes.

(From our own Correspondent in Paris.)

The Steel Trade.

THE efforts being made to bring about an international agreement amongst steel producers lead to the hope that something will be done before long to stabilise prices and create an atmosphere of confidence favourable to business. In France, steelmakers have placed themselves under the control of a triumvirate, which has arbitrary powers to limit production to home requirements, and at the same time prices on the home market are regulated to the extent that dealers are unable to sell at prices below those authorised by mill and forge owners. This control is only rendered possible by the system of import quotas which protect the home market from the competition of cheap foreign steel. In Germany the industry has undergone a gradual readjustment, and the falling off of the output appears to have been arrested. The tone of that market is more hopeful than it has been for a long while past. It almost seems as if optimism has been inspired by a desire to create confidence. While the exchanges of rolled iron and steel between France and Germany are limited by mutual agreement, there is nothing of the kind with Belgium, where some makers have refused to accept the quotas allotted to them, and the continued fall of export prices was due as much to the consignment of French and German steel as to the competition amongst Belgian makers themselves. The Belgians depend entirely upon their export trade, but they are undersold by the French and Germans, who have the advantage of getting remunerative prices on their own markets. This state of things has proved so disastrous for the Belgian steel trade that the resistance of the two firms which refused to accept the export quotas has now apparently been overcome. The meeting in Paris recently showed that all the Belgian producers have come to an agreement whereby it will be possible to arrange for a distribution of foreign business amongst the five countries belonging to the Cartel, that is to say, France, Germany, Belgium, Luxemburg, and Saar. The preliminary meeting in Paris is to be followed by another in Brussels next week. The first thing to be settled is the proportion of export business to be allotted to each country. Then quotas of production will be fixed, and finally a comptoir will be created for the distribution of foreign business and the control of prices. When that is accomplished the Steel Cartel will be definitely constituted on a new basis, and as all the members see the vital necessity of carrying these arrangements through with the least possible delay, there is every hope that, despite serious divergences over the allocation of quotas, it will be possible before long to place the steel trade on a really sound basis.

The Trans-Saharan Railway.

The Trans-Saharan Committee is profiting from the interest now being taken in public works to carry on another vigorous campaign for the construction of the railway across the desert to link up North Africa with the Niger Valley. The Bill to sanction the building of the railway has long been before the Chamber of Deputies, and the object of the promoters now is to drive it through Parliament under pressure of public opinion. It is stated that in these times of economic distress the Trans-Saharan scheme will result in the distribution of orders for railway and other material, machinery, and wagons to the value of more than 1000 million francs, and that this work will give employment to nearly 40,000 men during a period of four or five years. The objections to the railway are disposed of on the ground that it is quite an ordinary undertaking, and that there are no technical difficulties in carrying the line over a waterless desert. It will pass round sand dunes, and the only sand reaching the railway will be that blown on to it by storms. Experience in the South of Algeria has shown that this difficulty can be avoided by taking simple precautions. The use of oil-electric locomotives dispenses with the necessity of water supplies along the route, as sufficient water for cooling purposes can be carried for the whole journey. There will, it is said, be no difficulty in running trains across the desert all through the year, for in winter the coaches will be heated and in summer they will be ventilated with cold air. The entire journey will occupy about fifty hours. The Committee stresses the value of the railway as a means of bringing raw material from French West Africa, which it naturally expects to develop with the aid of railway communication. It further points out that the railway will be the first section of a system which will eventually join up with lines through the Belgian Congo and running down to the Cape.

The New Battleship.

A few more details are now available concerning the battleship "Dunkerque," of 26,500 tons, the construction of which was started last week at Brest. The two turrets, each carrying four 330 mm. guns, will be in front, one rising behind the other. The ship will have very strong protection, and with sixteen guns of smaller calibre and forty machine guns, it is believed that no seaplane will be able to approach it. The "Dunkerque," it is said, will be capable of holding its own against two 10,000-ton cruisers of the "Deutschland" class, and its speed and range of action will not be inferior to that of the German ships. It is not expected that the battleship will begin its trials before the end of 1936.

The Super-Mountain Locomotive.

Intended for the Transatlantic service between Paris and Cherbourg, a distance of 230 miles, which will be covered in just four hours, a locomotive constructed by the Compagnie Fives-Lille for the State Railways has been making preliminary runs from the Sotteville depôt, near Rouen. It is an improvement on the big "Mountain" locomotives now running on the Nord and Est railways. Its length is 90ft. and weight 128 tons. It has poppet valves for high-pressure steam and develops 2800 horse-power. The tender will carry 12 tons of coal and 7500 gallons of water. It is the first locomotive in France in which the grate is fed from the tender by a helicoidal stoker. It is being brought to the Gare Saint-Lazare, where it will be shown to the public, together with the original Buddicum locomotive which was in service when the old Ouest line was opened.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

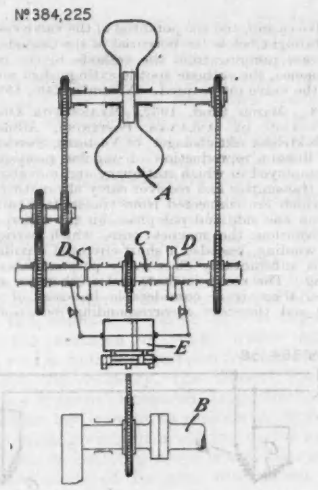
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

384,225. June 29th, 1932.—REVERSIBLE ENGINES PROVIDED WITH BLOWERS, A.E.G. Friedrich Karl-Ufer 2/4, Berlin, N.W.40, Germany.

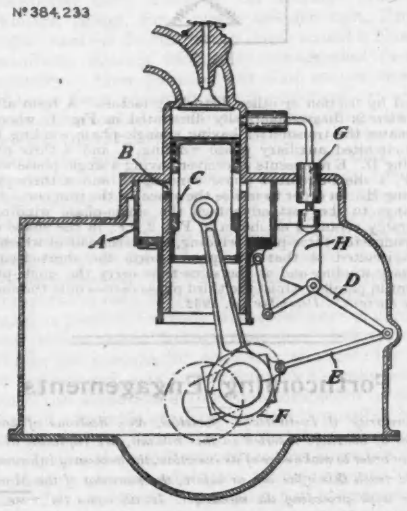
The blower A is driven from the crank shaft B of the reversible engine through the chain and toothed gearing shown. On the



countershaft C there are two clutches D D. These clutches are interconnected and operated by the servo-motor E. It will be seen that the engagement of either of the clutches will keep the blower running in the same direction regardless of the direction of rotation of the crank shaft.—*December 1st*, 1932.

384,233. July 8th, 1932.—TWO-STROKE ENGINES, "Fusion" Moteurs," Boulevard Galliéni, Rueil-Malmaison (Seine et Oise), France.

Outside the working cylinder there is the annular air pump A. The ports B are uncovered by the piston at the bottom of its



stroke to admit air to the cylinder. On the rising stroke air is admitted to the pump from the crank case through the ports C. The pump piston is operated by the bell-crank D and connecting-rod E, the pin of which follows the path indicated by the broken line F. The fuel pump G is worked by the cam H.—*December 1st*, 1932.

DYNAMOS AND MOTORS.

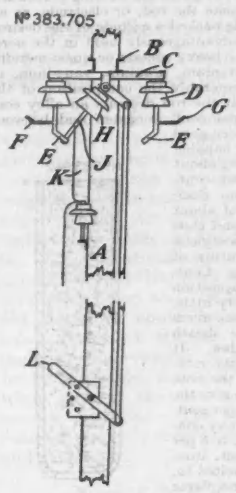
384,189. May 19th, 1932.—LAMINATED CORES FOR ELECTRICAL APPARATUS, *The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C.2.*

The object of this invention is effectively to insulate the sheet metal laminations of a laminated core structure in order to decrease the eddy current loss. The laminations are insulated from each other by an insulating coating or film including a basic iron phosphate compound. Sheet metal laminations of iron or steel, or alloys thereof, are provided with a basic iron phosphate coating. The plates to be coated are immersed in a solution of dilute phosphoric acid with iron scales (iron oxide) dissolved therein, the iron oxide serving as a source of iron and hastening the chemical reaction to form an iron phosphate coating on the surface. It is unnecessary to remove the iron oxide from the surfaces of the punchings. An iron phosphate coating has been found to be very effective as an insulating material, and as it forms a very thin film on the contacting surfaces of the punchings the number of punchings that can be stacked for a given height of core structure is considerably greater than when other coatings are used, with the result that a high space factor is obtained. Thus the eddy current loss is effectively decreased and the increase in the number of punchings per inch lowers the flux density required for the core structure and reduces the core loss. Another advantage is the high heat-resisting property of the iron phosphate coating. In casting conductors in a core structure aligned openings or slots are provided in the punchings and filled with molten metal, such as aluminium, which hardens after cooling to form conductor bars. The iron phosphate coating does not break down when heated by the molten metal and effectively insulates the bars from the punchings.—*December 1st*, 1932.

SWITCHGEAR.

383,705. October 3rd, 1931.—SWITCHGEAR FOR AERIAL ELECTRIC TRANSMISSION LINES, William Herbert Turner, of The Grove, Meanwood, Leeds; and William Herbert Isherwood, of 4, Caythorpe-road, Far Headingley, Leeds.

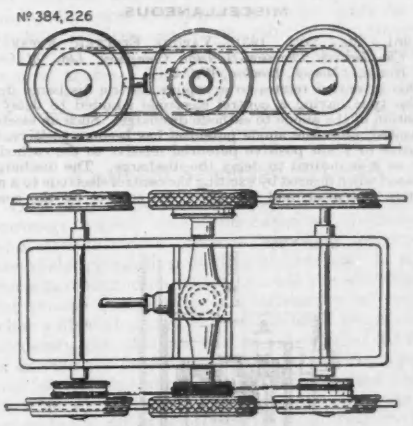
This invention relates to aerial electric transmission lines and particularly to the control gear or switchgear used for the purpose of connecting a branch line or a local transformer to one or the other of two alternative sources of supply or to one or other branch of a ring main, or for disconnecting the branch line or local transformer from both the alternative sources of supply. A is a wood pole forming part of an H pole structure, to which are bolted cross arms B, which in turn support a switch phase base C. Three of these bases would be provided for a three-phase system. At or near opposite ends of the base C and beneath the base there are insulators D, and upon the lower part of each insulator are contacts E and terminals F, G. Of these, terminal F would be connected to incoming line of one source of supply or branch of ring main, terminal G being similarly connected to the other source of supply or branch of ring main. Another insulator H, fitted with switch or contact blade J, is fitted near the centre of the phase base C and is pivoted to enable it to be engaged with either of the fixed contacts E or to remain in the disengaged or off position. From the switch blade J a flexible connection K is taken to the branch line terminal on the terminal of a local transformer, either directly or by way of an anchorage to a pilot insulator or post of insulators. The movable insulator H may be moved by an operating handle L arranged to padlock in either of three positions.—*November 24th*, 1932.



TRAMWAYS AND RAILWAYS.

384,226. June 30th, 1932.—RAILWAY BOGIES, L. Renault, 8, Avenue Emile Zola, Billancourt, Seine, France.

The inventor proposes a six-wheeled bogie of which four of

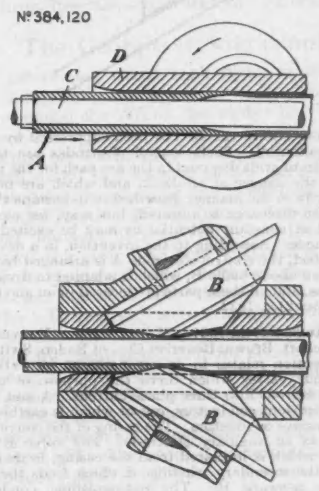


the wheels are of the normal flanged type, while the other two have pneumatic tires and are used only for propulsion and braking.—*December 1st*, 1932.

MACHINE TOOLS AND SHOP APPLIANCES.

384,120. January 27th, 1932.—TUBE ROLLING MILLS, Mannesmannröhren-Werke, 1B, Berger Ufer, Düsseldorf, Germany.

Tubes are produced from a pierced billet A by the action of



the disc rolls B B, while it is supported on the mandrel C. The reduction in thickness of the bloom by the rolls causes the tube walls to tend to expand on opposite sides of the mandrel in

directions at right angles to the plane extending through the axes of the rolls into an oval shape, but the sleeve D prevents the tube assuming such a form by confining the walls thereof and causing the tube to retain a circular cross section with a consequent stretching effect which results in an elongation of the tube.—*December 1st*, 1932.

WELDING.

383,942. August 15th, 1932.—WELDING RODS, Fried Krupp Aktiengesellschaft, Essen, Germany.

For some classes of welding by the fusion-deposition process, in which metals such as tungsten are employed, the melting temperature of those metals is so high that it is difficult to produce them in rods of a length convenient for welding procedure. The inventors consequently make the rod, or electrode, as an iron sheath, into which there is packed a carbide of the desired metal. Tungsten carbide is advantageously used in the core, but the carbides of such other heavy metals or quasi-metallic elements, as molybdenum, titanium, uranium, vanadium, or boron, may also be used. Preferably the composition of the whole welding rod is such that the rod deposits an alloy containing between 20 and 80 per cent. tungsten and between 0·5 and 6 per cent. carbon. Very good results are obtained with a rod capable of depositing an alloy containing about 62 per cent. tungsten, 4·3 per cent. carbon, and 32·7 per cent. iron. Such an alloy has a melting point of about 1800 deg. to 1900 deg. Cent. and thus can be melted in an oxy-acetylene flame which gives a temperature of from 2000 deg. to 2200 deg. Cent. During the deposition the composition of the sintered core alters very little, so that the deposited metal has much the same composition as the sheath and sintered core taken together. It is found convenient to make the ratio by weight of the sheath to the core about 1 : 4, so that the core to give the deposited alloy containing 62 per cent. tungsten, mentioned above, may contain 77·5 per cent. tungsten, 5·5 per cent. carbon, and 16 per cent. iron. When such a welding rod is melted in, for example, an oxy-acetylene flame the iron of the tube first melts and is heated so highly that the tungsten carbide, which is simultaneously highly heated, dissolves in the liquid iron. The electrical conductivity of the core is so good that a welding rod thus made can be used successfully in electric welding. Good fusion of the core with the iron of the tube is attained by adding to the core material, prior to the sintering, up to 30 per cent. chromium or chromium carbide, 5 per cent. silicon, and 10 per cent. manganese, particularly good results being obtained by addition of about 10 per cent. of chromium or chromium carbide, about 2 to 3 per cent. silicon, and about 3 to 5 per cent. manganese. The chromium and manganese constitute metals of lower melting point as defined above. The manganese and silicon are lost to a large extent during the deposition, but this has practically no effect on the properties of the deposited metal.—*November 24th*, 1932.

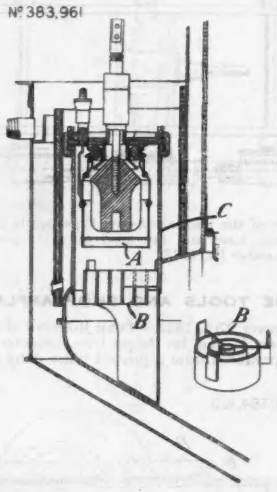
Nº 383,942

MISCELLANEOUS.

383,961. May 20th, 1931.—VAPOUR ELECTRIC APPARATUS, *The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C.2.*

This invention relates to a vapour electric discharge device of the type having a control electrode adapted to delay the initiation of the anode to cathode discharge. Such an electrode is excited, after the anode potential has become positive, to a negative or a low positive potential relative to the cathode so long as it is desired to delay the discharge. The discharge is initiated when desired by exciting the control electrode to a more positive potential, and thereafter the control by the control

Nº 383,961

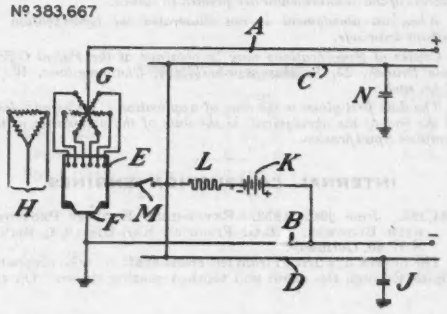


electrode ceases until the arc has been suppressed by reduction of anode potential. Such control electrodes are to be distinguished from grids disposed in the arc path for the purpose of decreasing the danger of arc-back, and which are not excited independently in the manner described to determine the instant at which the discharge is initiated, but may, for example, be maintained at constant potential or may be excited in phase with the anode. According to the invention, in a device of the type described, the control electrode A is arranged between the anode and an anode baffle B, which is adapted to divide the arc into sections, and all these parts are located in an anode housing C.—*November 21st*, 1932.

383,667. August 17th, 1931.—METAL VAPOUR VALVES, Aktiengesellschaft, Brown, Boveri et Cie., of Baden, Switzerland.

This invention relates to an arrangement for extinguishing metal vapour valves which serve the purpose of converting continuous current into three-phase current. A and B are the continuous current conductors, one of which is earthed. C and D are the reserve conductors. The casing of the converter valve is utilised as an auxiliary electrode. The valve E with the cathode F, which is insulated from the casing, feeds the transformer G, the secondary winding of which feeds the outgoing three-phase network H. The extinguishing condensers J, which represent the capacity of the reserve conductors C, D, receive an initial voltage by being charged from the battery K over the resistance L, the initial voltage causing the cathode to become positive. For extinguishing the valve the switch M is closed. On this being done the condensers are discharged by using the valve casing as an auxiliary electrode by way of the earth and the cathode. During the normal operation of the converter the condensers N are so charged that when the switch M is closed, the negative side of the condenser is put on

Nº 383,667



the valve casing, and the potential of the valve casing is momentarily brought below the potential of the cathode. This results in the arc jumping from the cathode to the casing, and, in consequence, the cathode spot is extinguished and the working arc in the valve interrupted.—*November 24th*, 1932.

384,158. March 22nd, 1932.—MEANS FOR DISTANT REPRODUCTION OF ANGULAR POSITIONS, Allmänna Svenska Elektriska Aktiebolaget, of Västeras, Sweden.

For distant reproduction of angular positions devices are often employed in which stationary and movable magnet cores at the transmitter and receiver carry alternating current windings, which are connected from transmitter to receiver single phase on one side and polyphase on the other. According to this invention the magnet core, which carries the single-phase winding, has also a short-circuited auxiliary winding in an axis substantially electrically perpendicular to the main winding. The result is that, under otherwise similar circumstances, there is a considerable increase of the adjusting torque and therefore a corresponding reduction of the error

Nº 384,158

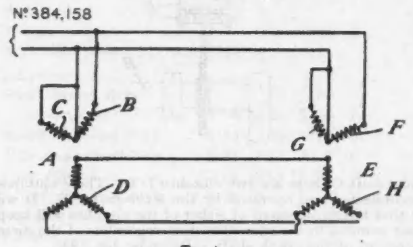


Fig. 1

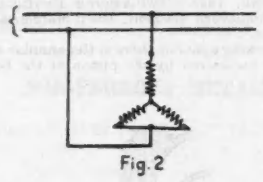


Fig. 2

caused by friction or other disturbing factors. A form of the invention is diagrammatically illustrated in Fig. 1, where A designates the transmitter having a single-phase winding B, a short-circuited auxiliary phase winding C, and a three-phase winding D. E represents a receiver having a single-phase winding F, a short-circuited phase winding G, and a three-phase winding H. In order to utilise the space on the iron core of the windings to the best advantage the single-phase winding is preferably arranged as shown in Fig. 2, *i.e.*, in the shape of a star-connected three-phase winding, two terminals of which are short-circuited so that two phases form the short-circuited auxiliary winding and at the same time carry the single-phase current in parallel, whilst the third phase carries only the single-phase current.—*December 1st*, 1932.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Monday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

JUNIOR INST. OF ENGINEERS.—39, Victoria-street, S.W.1. "Stress Recorders and their Use in Railway Bridge Work," Mr. G. F. Kent. 7.30 p.m.

RAILWAY CLUB.—57, Fetter-lane, E.C.4. "Liverpool Overhead Railway," Mr. J. Macnab. 7.30 p.m.

SATURDAY, JANUARY 7TH.

INST. OF BRITISH FOUNDRYMEN: LANCASHIRE.—College of Technology, Sackville-street, Manchester. "Phosphorous in Low Carbon Cast Iron," Mr. W. West. 4 p.m.

INST. OF ELECTRICAL ENGINEERS: N. MIDLAND STUDENTS' SECTION.—Visit to Leeds General Post Office. 2.30 p.m.

MONDAY, JANUARY 9TH.

CHARTERED SURVEYORS' INSTITUTION.—12, Great George-street, S.W.1. Meeting. 8 p.m.

INST. OF SANITARY ENGINEERS.—Caxton Hall, Westminster, S.W.1. Presidential Address, Mr. Henry C. Adams. 6 p.m.

TUESDAY, JANUARY 10TH.

BRITISH ASSOC. OF REFRIGERATION.—At Inst. of Mechanical Engineers, Storey's-gate, S.W.1. "Possibilities of Three-stage Compression in One Compound Multiple Effect Compression Cylinder for Low Temperatures, &c.," Mr. Henry Brier. 5.30 p.m.

ILLUMINATING ENGINEERING SOCIETY.—Watson House, Nine Elms-lane, S.W.8. "Laboratories at Watson House and Referring to Some Recent Developments in Gas Lighting," Mr. C. A. Masterman. 6.30 p.m.

INST. OF AUTOMOBILE ENGINEERS.—King's Head Hotel, Coventry. "Electrical Equipment for Automobiles." Mr. E. A. Watson. 7.30 p.m.

INST. OF CIVIL ENGINEERS.—Great George-street, S.W.1. "The River Hooghly Tunnel," Mr. C. M. Norrie. 6 p.m.

INST. OF ELECTRICAL ENGINEERS: S. MIDLAND STUDENTS.—University, Birmingham. "Ironbridge Power Station," Mr. J. Morton. 7 p.m.

INST. OF PETROLEUM TECHNOLOGISTS.—At Royal Society of Arts, John-street, Adelphi, W.C.2. "Aircraft in Relation to Petroleum Technology—Use for Survey and Transport," Mr. H. Hemming. 5.30 p.m.

SHEFFIELD METALLURGICAL ASSOCIATION.—198, West-street, Sheffield. Annual general meeting. Presidential address, Mr. J. H. S. Dickenson. 7.30 p.m.

WEDNESDAY, JANUARY 11TH.

INST. OF CIVIL ENGINEERS: STUDENTS.—Great George-street, S.W.1. "Impact Stresses in Bridges—Retrospect and Present-day Aspect," Mr. Conrad Gribble. 6.30 p.m.

INST. OF ENGINEERING INSPECTION.—At Royal Soc. of Arts, John-street, Adelphi, W.C.2. "Some Practical Aspects of Water Gauging and Measurement," Mr. W. G. Ardley. 5.30 p.m.

N. EAST COAST INST. OF ENGINEERS AND SHIPBUILDERS: GRADUATE SECTION.—Bolbec Hall, Newcastle-upon-Tyne. "Modern Boiler Plant with Pulverised Fuel Firing," Mr. V. C. Dixon and Mr. A. Hendry. 7.15 p.m.

SOCIETY OF GLASS TECHNOLOGY: LONDON SECTION.—Holophane, Ltd., Elverton-street, S.W.1. Discussion, "Automatic Temperature Control of Direct-fired Furnaces," Mr. W. A. Moorehead. 7.30 p.m.

TELEVISION SOC.—University College, Gower-street, W.C.1.—"Television System," Mr. E. H. Traub. 7 p.m.

THURSDAY, JANUARY 12TH.

INST. OF BRITISH FOUNDRYMEN: BURNLEY.—Municipal College, Ormerod-road, Burnley. "Scrap Castings: Common Faults in Common Practice," Mr. A. Jackson. 7.15 p.m.

INST. OF ELECTRICAL ENGINEERS: S. MIDLAND STUDENTS.—Visit to Wolseley Motors, Ltd., Drews-lane, Ward End, Birmingham. 3 p.m.

INSTITUTE OF METALS: LONDON LOCAL SECTION.—In the Rooms of the Society of Motor Manufacturers and Traders, Ltd., 83, Pall Mall, S.W.1. "The Zinc Industry," Mr. Stanley Robson. 7.30 p.m.

INST. OF STRUCTURAL ENGINEERS.—10, Upper Belgrave-street, S.W.1. "A River Wall in Reinforced Concrete," Mr. A. Wood. 6.30 p.m.

ROYAL AERONAUTICAL SOCIETY.—At Royal Soc. of Arts, John-street, Adelphi, W.C.2. "Airship Development Abroad," Squadron Leader R. S. Booth. 6.30 p.m.

FRIDAY, JANUARY 13TH.

CHEMICAL ENGINEERING GROUP.—Rooms of Chemical Society, Burlington House, W.1. "Corrosion Research on Light Metals," Mr. Freeman Horn. 8 p.m.

INST. OF MECHANICAL ENGINEERS.—Storey's-gate, S.W.1. "The Compression-ignition Locomotive and its Applicability to British Railways," Lt.-Col. L. F. R. Fell, D.S.O. 6 p.m.

INSTITUTE OF METALS: NORTH-EAST COAST LOCAL SECTION (Joint meeting with Society of Chemical Industry).—In the Electrical Engineering Lecture Theatre, Armstrong College, Newcastle-on-Tyne. "Corrosion of Metals in Salt Solutions and Sea Water," Dr. G. D. Bengough. 7.30 p.m.

INSTITUTE OF METALS: SHEFFIELD LOCAL SECTION.—In the Non-Ferrous Section of the Applied Science Department of the University, St. George's-square, Sheffield. "Metal Spraying," Mr. Kenneth Gray. 7.30 p.m.

JUNIOR INST. OF ENGINEERS.—39, Victoria-street, S.W.1. "Some Practical Notes on Vibration," Mr. J. Calderwood. 7.30 p.m.

N. EAST COAST INST. OF ENGINEERS AND SHIPBUILDERS.—Mining Institute, Newcastle-upon-Tyne. "Radiation in Boiler Furnaces," Mr. W. T. Bottomley. 6 p.m.

MONDAY, JANUARY 16TH.

INST. OF AUTOMOBILE ENGINEERS.—At Inst. of Engineers and Shipbuilders in Scotland, 39, Elmbank-crescent, Glasgow. "Electrical Equipment for Automobiles," Mr. E. A. Watson. 7.30 p.m.

INSTITUTE OF METALS: SCOTTISH LOCAL SECTION.—In the Rooms of the Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank-crescent, Glasgow. "Aluminium-bronze," Mr. F. Hudson. 7.30 p.m.

TUESDAY, JANUARY 17TH.

INST. OF AUTOMOBILE ENGINEERS.—Victoria Hotel, Wolverhampton. "Alloy Cast Irons in Automobile Construction," Dr. A. B. Everest. 7.30 p.m.

INST. OF MARINE ENGINEERS.—The Minories, E.C.3. "Oxy-acetylene Welding," Mr. H. P. Smith. 6 p.m.

WEDNESDAY, JANUARY 18TH.

DIESEL ENGINE USERS ASSOCIATION.—Caxton Hall, S.W.1. "Small Marine Diesels," Mr. O. Wans. 3 p.m.

INST. OF AUTOMOBILE ENGINEERS.—Metropole Hotel, Leeds. "Electrical Equipment for Automobiles," Mr. E. A. Watson. 7.15 p.m.

INST. OF CIVIL ENGINEERS.—Great George-street, S.W.1.—Informal meeting. Discussion, "Economic Disposal of Refuse," Mr. J. C. Dawes. 6 p.m.

ROYAL SOC. OF ARTS.—John-street, Adelphi, W.C.2. "Recent Developments in Infra-red Photography," Mr. Olaf F. Bloch. 8 p.m.

THURSDAY, JANUARY 19TH.

INSTITUTE OF METALS: BIRMINGHAM LOCAL SECTION.—In the University, Edmund-street, Birmingham. "Moulding Sands," Dr. J. G. A. Skerl. 7 p.m.

FRIDAY, JANUARY 20TH.

JUNIOR INST. OF ENGINEERS.—39, Victoria-street, S.W.1. "Notes on Welded Steel Work at Freemasons' Hospital," Mr. S. Bylander. 7.30 p.m.

MONDAY, JANUARY 23RD.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, W.C.2. Howard Lectures, "Thermal Insulation," Dr. Ezer Griffiths, F.R.S. 8 p.m.

WEDNESDAY, JANUARY 25TH.

INST. OF CHEMICAL ENGINEERS.—At Chemical Society, Burlington House, W.1. "Sewage Disposal." "British Practice in Sewage Disposal," Mr. H. C. Whitehead and Mr. F. R. O'Shaughnessy; "Sewage Treatment in America," Mr. L. R. Howson; "German Practice in Sewage Disposal," Dr.-Ing. Karl Imhoff. 5.30 p.m.

THURSDAY, JANUARY 26TH.

INST. OF CIVIL ENGINEERS: YORKSHIRE ASSOCIATION.—Royal Victoria Station Hotel, Sheffield. Annual dinner. 6.30 for 7 p.m.

FRIDAY, JANUARY 27TH.

INST. OF ELECTRICAL ENGINEERS.—Grand Hotel, Harrogate. Dinner and dance. 8 p.m.–2 a.m.

JUNIOR INST. OF ENGINEERS.—39, Victoria-street, S.W.1. "Some Experiments on Reinforced Concrete Slabs," Mr. R. H. Squire. 7.30 p.m.

MONDAY, JANUARY 30TH.

ROYAL SOC. OF ARTS.—John-street, Adelphi, W.C.2. Howard Lectures. "Thermal Insulation," Dr. Ezer Griffiths, F.R.S. 8 p.m.

A Seven-Day Journal

Railway Electrification in Italy.

IN pursuance of its policy to render the country as little dependent as possible on foreign coal, the Italian Government has decided to put in hand another plan of railway electrification which will continue that already completed, when the length of railways equipped electrically was brought up to 1304 miles. This has enabled the coal consumption to be reduced by 428,000 tons, as compared with the total for 1921. The most important electrified railways are those from Leghorn to Genoa, Turin and Modena. The new plan provides for the electrification of 2608 miles of railways during a period of twelve years at a cost of 4200 million liras. It is divided into three sections, each to be completed in four years. It will include the line down the peninsula from Milan to Reggio di Calabria on the Messina Straits, and also the one from Turin to Trieste, while the railways to the northern frontiers will also be electrified. At the same time, new hydro-electric power stations will be created to provide energy for the railways which, eventually, will be electrified throughout the country.

American Aircraft for the R.A.F.

THE Air Ministry has recently purchased a Vought "Corsair" two-seater seaplane, driven by a Pratt and Whitney supercharged 550 H.P. "Wasp" engine, and equipped with a Hamilton variable pitch propeller. This type of aircraft has been supplied to the United States Navy for some years for catapulting from warships. It can be adapted either as a land plane or as a single-float seaplane, and it is stated that the Air Ministry's machine will be provided with the equipment necessary for both alternatives. It is added that the Ministry's object in purchasing this aircraft is to test the merits of the single-float type of seaplane, and at the same time to acquire a typical example of the best American practice in aircraft construction. Single-float seaplanes have been tried in this country, but have never been extensively adopted. They possess lateral instability on the water, a defect which they share with single-hulled flying boats, and, in addition, are unsuitable for carrying torpedoes, a purpose for which British twin-float seaplanes are used to a considerable extent. In the Aeronautical Research Committee's report for 1931–32, it was revealed that the Marine Aircraft Experimental Establishment at Felixstowe was engaged upon an extensive investigation into the taking-off and alighting of seaplanes and flying boats. That there is still much to learn concerning the behaviour of marine aircraft when on the water is evident when we recall the peculiar action of the 1931 Supermarine Schneider Trophy twin-float seaplane during its preliminary trials. It was found impossible at first to get the machine off the water because at an early stage of the take-off run it swung violently to port, in spite of a full starboard rudder. The difficulty was eventually overcome by increasing the diameter of the air screw from 8ft. 6in. to 9ft. 1½in., although why a difference of 7½in. in the diameter of the air screw should make all the difference between total failure and success in getting off the water is not, we believe, even yet fully understood.

Smoke Abatement.

A MEMORANDUM has been sent out by the National Smoke Abatement Society to a large number of local authorities urging that further regional advisory committees such as those acting at present with some success in Greater London, the Midlands, the West Riding of Yorkshire, and in the Manchester district, shall be set up. In particular five new areas—Tyneside, Tees-side, North-East Lancashire, Merseyside, South-West Lancashire, and the Potteries—are mentioned, and it is suggested that the local authorities in these areas should co-operate. Much good work has been performed by the existing committees, which were set up with the assistance of the Ministry of Health. The object of the committees is to endeavour to secure greater uniformity in the administration of the law with regard to the emission of smoke, but greater importance is perhaps attached to the prevention of such emission. With the objects in view the committees are engaged upon standardising methods of taking observations, organising and encouraging training courses for stokers, and collecting data with respect to the latest devices for smoke prevention. It is pointed out in the memorandum that the cost of such advisory committees to the constitutent local authorities is very small, two guineas being the maximum annual subscription.

Britain's Industrial Position.

SPEAKING before a meeting of the Conservative Club in Edinburgh, last Friday, January 6th, Lieutenant-Colonel Colville, Secretary of the Department of Overseas Trade, quoted some cheerful figures to show the improvement in Britain's financial and industrial position. Figures of the export trade for the whole of 1932 were not, he said, yet available, but comparing the first eleven months of 1932 with the corresponding months of 1931, there had been a reduction of £106 millions in the visible adverse balance of trade. The increased purchase, in recent months, of raw materials was perhaps the best indication of the slow recovery of the trade of the country. Comparing November with the preceding month, he said that imports of raw materials showed an advance of nearly £2 million. The increases occurred principally in raw cotton, raw wool, papermaking materials, and rubber. Exports of manufactured goods had necessarily shared in the shrinkage of trade throughout the world, but even there it was gratifying to find that the iron and steel industry and machinery showed further significant improvement during November. The general tone throughout the country was slightly firmer and healthier in the basic and other industries.

Steel Frame Buildings in London.

ON Tuesday last, January 10th, representatives of the Building Research Station of the Department of Scientific and Industrial Research attended a meeting of a joint committee of the District Surveyors' Association and the British Steelwork Association, which has just concluded the first part of its inquiry into problems arising out of the interpretation of the new London County Council Code of Practice for Steel Frame Building Construction. The research work now in progress was outlined and the committee was invited by Dr. R. E. Stradling, the Director, to visit the Building Research Station. Mr. C. J. Kavanagh, the director of the British Steelwork Association, said that the inception of the joint committee had been inspired by the desire of all parties to secure the smooth working of the regulations governing the erection of steel frame buildings in London, and to maintain full and friendly co-operation between the industry, the district surveyors, and the Government Research Department. The joint committee had sought to remove every obstacle to efficient building without involving undue expense. The economies in building costs which had resulted from the new Code of Practice introduced by Sir Robert Tasker's Committee at the London County Council should, he suggested, encourage all potential builders of property to reconsider projects which might have been in cold storage recently, and to make the best of the present opportunity afforded by reduced building costs and the maximum economy in construction.

Industrial Management.

THIRTY-ONE authorities, among whom are numbered Lord Amulree, Sir Herbert Austin, Sir William Bragg, Sir Francis Goodenough, Professor Inglis, and Sir Josiah Stamp, have issued a New Year manifesto dealing with the management factor in industry. After pointing out that management has hitherto been regarded as an empirical art and the methods adopted in various undertakings have expressed the intuitive policies of the men who founded them, the manifesto goes on to state that modern conditions call for a somewhat different treatment. Suggestions for the improvement of management are included. The use of statistics by which results may be compared and measured and estimates be made of the present or the potential demand for any product is recommended. By this means, too, the intensity of competition may be gauged while the figures collected make it possible to study the preferences of consumers and many other factors that may influence sales. While the reasons for economic changes, for booms or depressions, may be too complex to make prophecy easy, the manifesto states that competent interpretation of economic statistics makes it possible to look ahead with a decreasing probability of error. In conclusion, the manifesto states that there is a definite tendency towards education for management, and it appeals to industrialists as an act of insurance as well as of patriotism to sponsor a movement designed to raise the standards of management of less efficient firms. The inefficient firm, it is stated, is not only in perpetual peril itself; it imperils and menaces the future of British industry as a whole.

Road Design.

ADDRESSING a meeting of the Institute of Transport on Monday, Mr. H. E. Aldington had much of interest to say with regard to road engineering in relation to the safe movement of traffic. Some of our present traffic difficulties, he considered, were to some extent due to our highways being not yet entirely out of the horse-and-carriage stage. The problems of designing smooth and durable road surfaces had been overcome, and the present demand was for improved design capable of providing for the continuous movement of high-speed traffic. Mr. Aldington stated as a doctrine that the traffic capacity of the intersections should be at least equal to the capacity of the converging roads. Continuous movement would result if the intersections were so designed. To illustrate the point, he suggested that besides being more efficient, it was cheaper to build a 40ft. road with crossings which provided for continuous movement than to construct a 60ft. road with the conventional right-angled cross. At the same time the narrower road would be the safer. As far as cities were concerned, the solution for many traffic difficulties lay in untying the knots of traffic that occurred at every important crossing and obtaining a more even distribution of the vehicles over the surface of the highways. He recommended that for general safety a uniform speed of about 15 to 20 miles an hour would seem to be ideal, but pointed out that the present arrangement encouraged the traffic to travel in bursts of high speed between blocks, although the average speed was low. The irregular spacing of the vehicles caused wasteful use to be made of city highways.

Bridge Reconstruction in Glasgow.

THE old London, Midland and Scottish Railway bridge which crosses the Saltmarket at Glasgow is to be reconstructed. The work was begun last week-end, and will continue over the next two week-ends, only that part of the work which can be carried out without stopping the railway and tramway traffic being done throughout the week. The plans prepared by the railway engineers for the new bridge allow part of the street below it to be utilised for traffic other than the tramcars which at present use it. The operations carried out last week-end were concerned with the east side of the bridge, and the rails were lifted and the ballast cleared, so that the old steelwork could be removed. This was later taken away in trucks. The reconstruction work includes the renewal of the entire decking of the bridge and the erection of a new superstructure, while part of the masonry of the abutments will receive attention. The old main girders are to be retained, but the present cross girders will be removed and replaced.

New L.N.E.R. Rolling Stock.

THE London and North-Eastern Railway Company announces that it has decided to construct 278 new passenger vehicles during 1933. Included in the new stock are restaurant cars, buffet cars, first and third main line carriages, and brake vans. Five new trains are to be built for special traffic. Each will consist of ten carriages and two buffet cars, capable of carrying 600 passengers, or, if divided into two, 300 passengers with a buffet car. The new trains, which are to be completed by July, are of an entirely new design, and will be given a distinctive colour. They will be used between Lancashire, Yorkshire, and Midland towns, and London and seaside resorts. Eighty-five new carriages are to be built for East Anglian services, and new vehicles for Newcastle, Liverpool, and Newcastle–Bournemouth through express trains. The new coaches on the Scottish section will be used on the lines from Edinburgh to the North of Scotland on the east coast route, and on the Glasgow–Fort William west coast services.

Eastleigh Sewerage Scheme.

ONE of the many interesting features of the new sewerage scheme opened on Saturday, January 7th, by Eastleigh Urban District Council, is the proposed use of sludge gas in providing electricity. At present the generating units which provide the electricity for the pumps and lighting are driven by oil fuel, but when sufficient sludge has accumulated to give off the necessary gas, this gas will be substituted for the oil in driving the engines. Capable of serving a population of 40,000, the scheme has been carried out at a cost of £101,900; £30,000 of this sum has been expended in direct labour. The consulting civil engineers were Messrs. A. P. I. Cotterell and Son, MM. Inst. C.E., chartered civil engineers, and the consulting electrical and mechanical engineer was Mr. T. W. Ellis, M.I. Mech. E., M.I.E.E., both of Westminster, and the work was carried out under the supervision of the engineer and surveyor to the Council, Mr. F. G. Lee, M. Inst. M. & Cy. E. The new scheme embodies the construction of two pumping stations with rising mains to the disposal works, and the construction of an entirely new disposal works and generating station.

The Georgic at Southampton.

AN interesting event took place at Southampton on Monday last, January 9th, when a luncheon was held on board the White Star motor liner "Georgic," to mark the occasion of her first visit to that port. She sailed on Wednesday at mid-day for New York, and will make two sailings in the express service of the company in place of the "Olympic," which is now under repair. Mr. E. Trevor Lewis, the Southampton manager of the White Star Line, welcomed on board the civic and port authorities and Southampton shipping officials. In the course of his speech he pointed out that the "Georgic" and her sister ship the "Britannic" were amongst the finest cabin class vessels afloat. They had been designed, he said, not for great speed, but for comfort at a reasonable cost, and they carried cabin, tourist, and third-class passengers. As cargo carriers, Mr. Lewis continued, the ships were second to none in their facilities for cargo stowage and quick and efficient loading and discharge. The Mayor of Southampton, Councillor F. Woolley, paid a tribute to the new White Star liner, and Mr. G. R. Newcombe, the docks and marine manager, expressed the hope that although the "Georgic" was at present domiciled in Liverpool, she would eventually sail from Southampton.

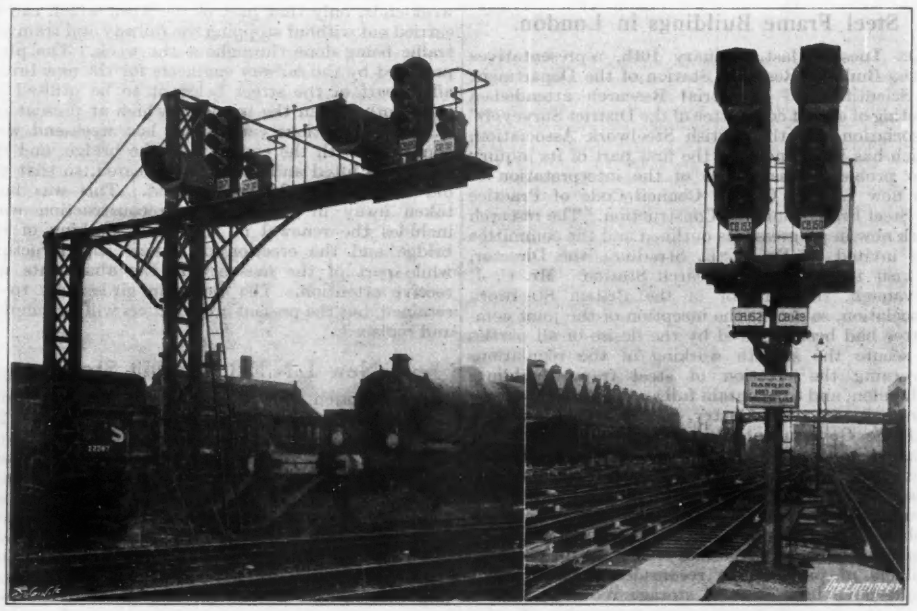
The Re-Signalling of Brighton Station.

THE former Brighton line—officially known as the London, Brighton and South Coast Railway—was the pioneer in the use of many railway safety appliances. It was the most active in the adoption of continuous brakes and of communication between passengers and the men in charge of the train, and was the first to use electricity for train lighting. It was, moreover, pre-eminent in signalling, as the first semaphore signal and the first interlocking of points and signals was introduced at Bricklayer's Arms Junction on that line—the former at the end of 1841 or the beginning of 1842, and the latter in 1843. It may also appropriately be remarked that the founders of the well-known firm of Saxby and Farmer were both "Brighton" men; the former had been in the engineering department and the latter in the traffic department.

The interlocking at Bricklayer's Arms was designed by John Saxby and was patented in 1856. An improvement therein was made by Austin Chambers in a frame fixed on the North London Railway in 1859, and Saxby made another improvement in 1860. One of the first frames to be made under the last-named patent was one of thirty-seven levers, which was fixed in the then South Box at Brighton in 1861–62. Later, Brighton station was enlarged and re-signalled, and among the boxes then erected was a new South Box, which was provided with a frame of 240 levers, and a West Box with 120 levers. The replacement on October 16th last of those two boxes and four others, which together had a total of 595 levers, by one central box with 225 levers, as part of the electrification by the Southern Railway of the lines southward from Coulsdon to Brighton and Worthing, deserves to be placed on record.

The use of electrical power, instead of mechanical operation, for the actuation of points and signals permits a very much wider area to be controlled from one signal-box than was formerly possible. That improvement is not wholly due to there being practically no limit to the distance at which points may be situated from the signal-box whence they are worked—the Ministry of Transport requirements limit that distance when mechanically operated to 350 yards—but the use of track circuit renders it less necessary for a signalman to command a view of the roads he controls. Added to the latter feature, there is the illuminated diagram, showing the condition of the track circuits, whereby the man can readily tell whether or not tracks are occupied and whether points are fouled. These advantages are described in some detail later.

As a preliminary, some of the benefits of power operation can be seen by contrasting the equipment of a mechanically worked box with a power-operated box. There being no occasion to use rodding or signal wires for the power actuation of points and signals, the familiar host of rods and wires which are to be seen under and outside of hand-operated boxes is done away with. There is also the greater safety for men working and walking on the track, since there is no point rodding nor any wires for them to trip over. Additionally, because the levers require half the distance apart from each other, less space is required for the locking frame in the signal-box, which, consequently, may be made smaller, and, because no lead-away for the point rodding is required, can be placed in positions that would be inconvenient for a mechanical box. Finally, the signalman's work is compressed, and he has less walking to do.



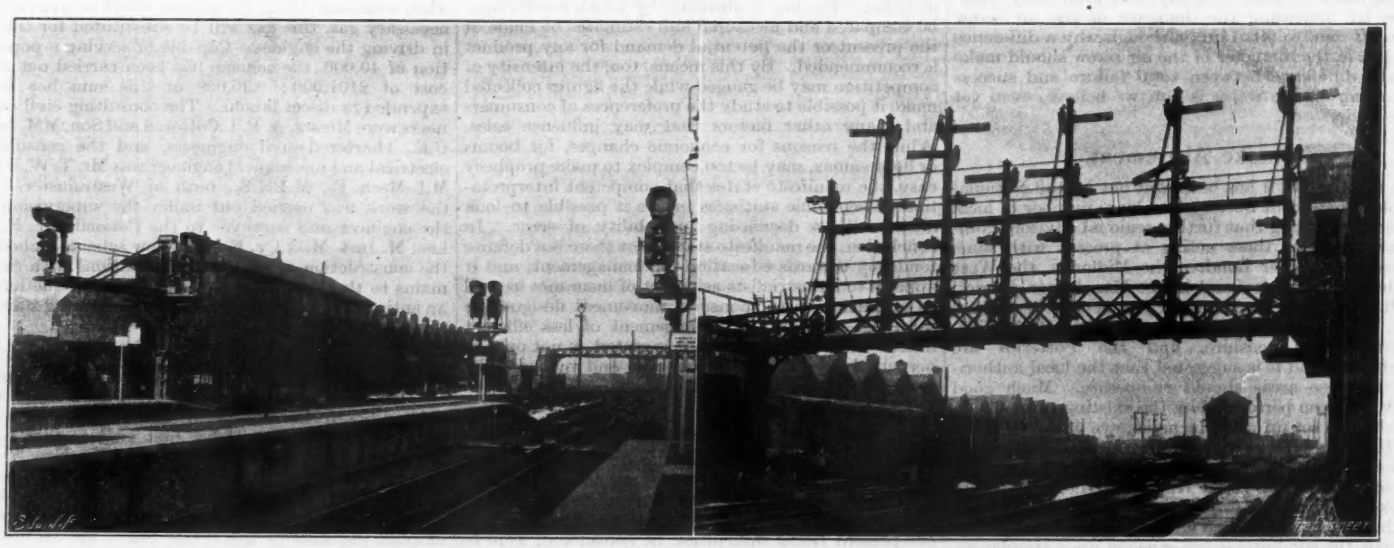
Figs. 1 and 2—New Signals; showing the three Colour-Lights, the Side Lights, the small Shunting Signals (below), and the Route Indicators.

Two views on page 44 show the exterior of the former South Box at Brighton and the interior with its 240 levers. The greater adaptability of a power-operated box can be appreciated from the two views on the same page of the new box at Brighton. It is erected on the wall of the locomotive shops and all the means required for the movement of the points and signals are contained in the cables to be seen at each end of the structure. A comparison with the interior of the old South Box with its 240 levers with the inside of the new box, which has 225 levers, reveals the less space required and the compactness of the locking frame. The contrast between the heavy levers with which the signalman had to labour and the miniature levers they now operate, with no more exertion than in turning an electrical switch, is very evident.

The new locking frame at Brighton has a feature which is entirely new. In order to give the signalmen greater command over their work, and to enable them to see more readily what each other is doing, the frame has been built in three sections with the two outer sections at an angle of 120 deg. to the centre section. This has only been made possible by interlocking the various levers electrically. That was done for the first time at North Kent East Junction, London Bridge, on December 1st, 1929. Previously, the interlocking in power-operated frames was of the same construction as in mechanical signalling, but smaller, and the interlocking rods ran the whole length of the frame in longitudinal channels which had to be continuous. The abandonment of that form of interlocking—introduced, as said above, over seventy years ago—was a bold venture, but three years' experience in a busy box outside London Bridge has justified it.

THE ILLUMINATED DIAGRAM.

We may refer to the illuminated diagram in the new box, which, it will be seen, is suspended above the locking frame. It is in duplicate, one diagram for the north end of the box and one for the south end, and is a reproduction of the diagram of Brighton Yard, with its points and signals. We may recall that a "track circuit" is a length of line isolated from its adjacent lengths by insulation at the rail joints concerned. The rails in the section are bonded together by wire, and current from a battery flows through, say, the left-hand rails to a relay at the other end of the section, so that the relay is energised. The current then returns by the right-hand rail to the battery. The relay can perform various duties. It can lead to the operation of an automatic signal or to the locking of a lever. The former can be readily visualised, and it will also be easy to see how a train or vehicle, when entering the track circuit or standing in a position of danger, will short-circuit the current, de-energise the relay, throw the signal to "Danger" or lock the levers of points and signals that should be held whilst the train or engine stands foul. Mention was made above, when the locking frame was referred to, of electrically operated control locks. On the illuminated diagram each of the 118 track circuits is represented by a strip, in which is placed a miniature electric bulb connected to the track relay. When the track circuit is unoccupied a white light is exhibited; when a train or vehicle is on it the light is out. The signalman can thus see whether a road is obstructed or free, and he can, further, witness the approach, passage, and clearance of a train. Thus we see how the illuminated diagram—a British invention, by the



Figs. 3 and 4—The New Colour-Light Signals and an old Signal Gantry.

way—assists in eliminating the necessity, which formerly prevailed, for a signalman to be able to see all the roads he controlled.

THE LOCKING FRAME.

The actuating levers in the locking frame are nothing more than electrical switches which close the electrical power circuit for operation to the motor which moves the points. The circuit is broken whilst the levers are in their normal—or back in the frame—position, and made whilst the lever is in its travel, and again broken when the lever is over—"reverse" is the technical term. When the points have to be restored, the initial movement of the lever in its return travel reverses the current, so that the motor operates in the opposite direction, and puts the points to their normal position. There is also electrical detection—another form of control lock—to ensure that the condition of the points corresponds with the position of the lever, and, if the points have a facing point lock, that the plunger of the lock is in position in order to hold the points. In the earlier forms of power operation the full stroke of the lever, either to the reverse or the normal position, was restrained, when nearing completion, by an intermediate check lock, which was afterwards withdrawn by the return current from the points when fully moved. Thus the lever could not be pulled straight over or pushed back until its work was finished. That is not, however, now done; the full stroke is at once made, and reliance placed on the control locks. Current for the signals is switched in when the lever is pulled, certain relays being energised to give the required aspects. The relays are de-energised when the signal lever is put to normal or the track circuit involved has been occupied.

The condition of the points and signal actuated by each lever is repeated by the small illuminated discs behind the levers—each lever has its own repeater. Points have only two discs, an upper, N, for normal, and a lower, R, for reverse *i.e.*, for the back and the over positions of the lever, and one or other of the discs gives a white light to correspond with the condition of the points. The repeaters of the signals record, by colour, each aspect that can be displayed by the signal concerned, and there are control locks here which ensure that a signal has responded to its lever when it is put to normal and should indicate "danger." As we shall see directly, the larger proportion of the running signals apply to entering on to one of several roads and, instead of there being, for instance, eight signals for leading off the down local line into one of the Nos. 10 to 3 platform roads, there is only one signal which, when changed from "danger," is accompanied by the exhibition of a numeral, corresponding to the intended road, on a route indicator by the side of, or above, the signal. On the left of the two sets of signals seen in Fig. 1 is the signal, and its route indicator, just named as governing the down local line; the other signal and route indicator are for the down through line. The miniature signals are shunt signals, to which, however, we need not refer.

THE SIGNALS.

Leaving the signal-box and coming to the lay-out of the yard, we may note that access into any one of the platform roads Nos. 10 to 3 inclusive can be obtained off the line from Lewes and from the down local line and the down through. The line from Lewes has one common signal which is operated by any one of eight levers—No. 2 to No. 9—according to which of the eight platforms the train has to be turned into. The down local has a similar signal, actuated by any one of Nos. 71–78, and the down through has one controlled by Nos. 89–96. From the Hove direction there is access only to Nos. 3, 2 and 1, and so the up west branch home signal has three levers, Nos. 181–183. Each platform has a starting or departure signal and Nos. 3 and 2 roads have outer starting signals because of the connections in the middle of those lines. The starting signals at the outer end of Nos. 3–10 platforms can give access to the up through or the down east branch, and so they have route indicators that give T for the up through and B for the branch. They also have shunt signals. In the rear of these signals are intermediate platform signals which repeat the condition of the starting and shunt signals. They, too, have route indicators wherein the letter M shows that the signal exhibited is repeating the starting signal and the letter S the shunt signals.

Two rods lead from the point mechanism. One is for the facing point lock and the other for moving the switches. A plunger lies normally in one of two slots cut in the facing point lock rod. The first action of a motor, which is inside a case at the side of the line, is to withdraw the plunger from the slot and thus to unlock the points; the next movement is to operate the rod to the switches, and the final action is to insert the plunger in the other slot and so hold the points in their new position. Additionally, there is a separate rod from each switch of the points. These are employed for detection—part of the control locks in the lever frame—and one switch of the points must be fully closed against its stock rail and the other must be fully open, and, moreover, the plunger must be in the correct slot, before the current can return to the operating lever and show that it has done its work.

The signals employed throughout are of the colour light type, wherein the night indications given by red, yellow and green lights act also for the signals given by day. That is done by means of light of strong penetrative power, and the possible interference by the rays of the sun is met by providing hoods over the lamps. The result has been a quite unexpected success, one of many advantages being that fog-signalmen are found to be unnecessary. Another advantage is that the signals need no sky background and can be brought nearer to the level of the driver's eyes. A further benefit is that it has been possible to provide another symbol in the shape of a double yellow aspect. That is useful in what are known as short sections where the indication that corresponds to a distant warning is not given at the full braking distance from the next stop signal. An outer warning is now given by a double yellow which signifies "Warning; be prepared to find the next signal at 'Caution'," and the single yellow says, "Caution; be prepared to find the next signal at 'Danger'." The possibility of a driver, when standing at a signal, being out of the rays of light, is met by side lights in each unit which repeat the indication that is being displayed.

Fig. 3 shows, reading from left to right, the starting signals from Nos. 3, 4, 5, 6 and 7 platform roads, all of which have the route indicator above the signal. The old South Box, now dispensed with, is on the left. Fig. 2 illustrates the starting signals for Nos. 5 and 6 platform roads. This is reproduced, partly to give a closer view of the signals; partly to show, on the extreme right, the unusual, but very practical, position of the signal-box; and partly to indicate more clearly the side lights with which each aspect of the signal is provided. The top unit is for green; the middle for yellow, and the bottom for red. When there is a double yellow the second yellow is below the red and thus the space taken up by the third lamp separates the yellows in the second and fourth.

As an example of the former signalling we give, in Fig. 4, a view of the signal gantry which spanned the lines outside the former South Box. The arms that point to the right were the arrival signals and have been displaced by the home signals for the east branch and the down local and down through. The arms that point to the left are departure signals which are no longer necessary. The end of the new box is seen on the extreme right.

Additionally to the re-signalling of Brighton Station and yard, and of Preston Park, the lines between Coulsdon and Preston Park, except two of the four between Coulsdon and Earlswood, have been equipped with automatic signalling of the colour-light type. This has led to a remarkable economy in the number of signal-boxes, seeing that, under automatic signalling, signal-boxes and signalmen are no longer necessary for block-signalling the trains; these are only required where, and when, points have to be worked. As was shown in our opening remarks above, the concentration in Brighton yard has saved five signal-boxes at that place alone. Between Coulsdon and Preston Park inclusive there were thirty-three other boxes, and of these twenty have been entirely dispensed with. Moreover, of the fifteen that remain nine are open only when point movements have to be made; at other times the signals there work automatically.

The officers of the Southern Railway are to be congratulated on this most interesting feature in the electrification of the line to Brighton. Praise is also due to the Westinghouse Brake and Saxby Signal Company, Ltd., which provided all the signal material. The work itself was carried out by the railway company's own forces, except the locking frame at Brighton, which was not only made by the Westinghouse Company at its works at Chippenham, but erected, locked, and tested by that firm.

Harbours and Waterways in 1932.

No. II. (*conclusion*).*

EUROPEAN PORTS AND WATERWAYS.

WE referred briefly a year ago to the works which have been in progress for nearly three years at Le Verdon on the southern side of the Gironde entrance, and have as their object the provision of a deep-water port of call for Transatlantic passenger liners, 37 miles nearer the open sea than the quays at Bordeaux. The mole, with its equipment of a passenger station and other buildings and four railway tracks, is connected with the land by a curved viaduct, and it is expected to be ready for service in the early summer of 1933. The straight part of the mole itself is 317 m. long and 38 m. wide, and the least depth at low water is about 43ft. A somewhat novel method of construction has been adopted for building the piers which support the mole and the viaduct. The shells of the piers, each in the form of a reinforced concrete cylinder of 13ft. diameter with an enlarged bellmouth foot, most of them being over 86ft. long, were made on shore, launched, floated out, and sunk in the sandy bed of the estuary by a combination of pumping and water-jetting. When each cylinder had been sunk to a firm foundation in the underlying clay, it was filled with concrete. In all, ninety-six of these reinforced concrete piers have been sunk to form the substructure of the mole and its approach viaduct. The superstructure of the work is of massive reinforced concrete carried by the piers. All transverse and longitudinal stiffening and bracing beams are placed above the level of half-tide, and there is no connection between the piers below that level.

Another port of call for Transatlantic liners is being constructed at La Pallice, near La Rochelle. Work was begun in the summer of 1931, but suffered a setback during the past year, owing, it is said, to misleading data derived from borings which had previously been made to prove the nature of the substrata on the site of the mole. The mole is to be constructed in a depth of at least 35ft. at lowest low water, and will be connected with the shore by an approach viaduct. Work on the viaduct was continued during the year, but the building of the mole itself has been suspended pending the reconsideration of its design. The new deep-water quay for large ships at Cherbourg, begun in 1928, was used for the first time by a Transatlantic liner on December 15th. The quay is founded on reinforced concrete caissons sunk through the soft bed of the harbour to the underlying rock.

The western extension of the Joannès-Couvert deep-water quay at Le Havre was completed at the end of 1932. It is 175 metres in length and consists of a series of reinforced concrete caissons sunk by compressed air to a depth of about 89ft. below quay level. The eastern extension of the quay, completed in 1930, is founded at a depth of 97ft. below quay level. The berth in front of the quay is dredged to a depth of 40ft. below lowest low water. This work completes the deep-water quay, 1175 metres in length, which has been in course of construction since the War in the new tidal harbour at Le Havre. A good deal of the equipment of the quay and the building of a maritime station still remain to be carried out.

The launch of the new French liner "Normandie," by far the largest ship now afloat, at Saint Nazaire on October 29th, gave occasion for the use of the new combined lock and dry dock which has been built in the port to accommodate the great ship. The foundation stone of the new dock was laid in April, 1930. The structure has an internal length of 1145ft. and a bottom width of 173ft. In addition to serving as a dry dock, it forms a means of communication for the largest vessels between the basin of the shipyards at the port and the sea.

A new quay on the left bank of the Loire at Nantes was brought into use during the year. In October some of the reconstructed berths in the old Joliette basin at Marseilles were formally inaugurated, but work generally on the great programme of port extension seems to have been slowed down during the year owing to the unsatisfactory financial situation. The harbour improvement works at Dieppe are reported to have been postponed for the same reason.

There seems to have been but little slowing down in the work of improving and extending French inland waterways on which so much money has been expended in recent years. In August the President of the Republic inaugurated the new Metz-Thionville Canal, which serves the iron mines in the locality through which it runs. The work was begun early in 1929. The canal is 19 miles long and has cost upwards of £1,600,000 gold. At present the canal can accommodate barges carrying 300 tons, but it can be widened and deepened later for barges of 1200 tons capacity. A part of the river Moselle has been canalised and a lateral canal made. The construction of several locks and barrages has been necessary for the regulation of the water levels in the canal and the canalised portions of the river.

Plans have been approved for a further extension of the training works at the mouth of the Seine with the object of increasing the depth of water available in the ship channel through the sands, which constitute such a serious problem in the lower part of the estuary of the river. It is hoped that these works will increase the available depth for shipping going up to Rouen to a minimum of 8 m. at low tide.

The development of mechanical traction on the canals of Northern France has proceeded in recent years mainly in the direction of an increased use of tractors running on rails with overhead trolleys taking current supplied by sub-stations at intervals of about 12 miles. It is reported that over 420 miles of canals in Northern France are now being worked on this system of haulage.

On October 9th the President of the Republic formally opened the hydro-electric power station at Kembs, on the river Rhine, below Basle, and the

* No. I. appeared January 6th.

first section of the Alsace Canal, which forms parts of the plan to construct a lateral waterway from near the Swiss frontier to Strasbourg. The scheme has two main objects, namely, to ensure a regular navigation on the Rhine at all seasons and to utilise the difference in the water level between Basle and Strasbourg for the production of energy. From the point of view of navigation the utility of the short Kembs section is unquestioned, for it removes the most serious difficulty in the navigation of the Upper Rhine by enabling barges to avoid the rocky Istein bar. The length of the canal now brought into use is about 3¾ miles, and it is 80 m. wide at the bottom with a maximum depth of 12 m. The barrage across the Rhine raises the level of the river above it by nearly 23ft. The power station, which it is expected will be in operation this year, will, it is said, be the largest in Europe. The cost of the works to date is stated to be £5,200,000 gold. Work was begun on the project in 1927. The capacity of the Kembs power station will, when it is fully equipped, be something like 200,000 H.P. We published an illustrated description of the canal and power station in our issue of August 26th last.

The great dyke across the Zuider Zee from North Holland to Friesland was closed on May 28th. The Ysel Lake, which is the name given to what will remain unreclaimed from the Zuider Zee, was thereby isolated from the sea. The roadway and railway along the top of the dyke still remain to be completed. The construction of the main enclosing dyke was begun in 1927. The dyke is about 18½ miles long. In our reference to this great work a year ago we mentioned that the Netherlands Government had, owing to the financial situation and the uncertainty with regard to the development of agriculture, suspended work on the reclamation of the south-east and south-west polders of the Zuider Zee scheme. In the course of the year the Government also decided to defer the reclamation of the north-east polder. In the face of determined opposition to this policy, the responsible Minister in November last announced that proposals would shortly be made for continuing the reclamation scheme on the north-east polder, which is that which will adjoin the Friesland shore of the old Zuider Zee. It will be remembered that the first of the four polders, the north-western or Wieringen polder, was dried out in September, 1930. A considerable part of the area of this polder is now under cultivation and several villages have been constructed.

The Juliana Canal, which will form the final link of the improved navigation between the Waal at Nymegen and the Meuse at Maastricht, is practically completed, but has not yet been handed over to navigation. It has a length of about 25 miles. The remaining section of the navigation from Nymegen to Maastricht is by way of the canalised Meuse and a short section of canal linking the Meuse to the Waal at Nymegen. The navigation is now capable of taking barges of 2000 tons capacity.

The long-continued negotiations between the Belgian and Netherlands Governments for the revision of the Treaty of 1839 concerning navigation in the Scheldt have not yet been concluded. Agreement has, however, been reached about the feeding of the Dutch Juliana Canal from the waters of the Meuse in return for concessions made to Belgium which will enable other canals to be constructed by that country.

In Germany a barge lift of 1000 tons capacity has been constructed at Niederinfienow, where the Hohenzollern Canal joins the river Oder, forming the Berlin-Stettin waterway. The difference in level of the two sections is 110ft., which has hitherto been overcome by passing barges through a flight of four locks. The barge lift has taken about six years to construct and the cost is stated to be about £1,200,000 gold.

It is reported that the canal which the Soviet Government is making between the White Sea and the Baltic is approaching completion. Its northern outlet to the sea is at Soroka, on the sourthern shore of the White Sea. The length of actual canalisation is about 140 miles, the large lakes Onega and Ladoga, and other smaller lakes as well, being available as part of the navigation. A considerable portion of the route consists of canalised rivers and, between Lake Ladoga and the Gulf of Finland at Leningrad, the navigation is by way of the river Neva. It is said that at first the depth will be sufficient only for small craft and timber rafts and that in all there are nineteen locks. The canal is expected to be ready for traffic some time this year. It is also reported that the Soviet Government has decided to commence at once the construction of a canal between the Volga and Moscow rivers.

In Italy the new port works at Bari were proceeded with energetically and the first section of the breakwater is expected to be completed at an early date. In October the large new quay which has been building at Naples for some years past was brought into use.

Port works of some magnitude are being carried out at Leixoes and Espinho, near Oporto. The Leixoes extensions include an outer mole, 1000 m. long, on which work began in August, the contract being in the hands of a Netherlands firm. The deep-water pier, 500 m. long, at Durazzo, on the Adriatic coast of Yugo-Slavia, is expected to be completed during the present year.

AFRICA.

The revised scheme of harbour construction at Port Elizabeth made progress during the year. The north arm of the harbour, which is being constructed in the form of a rubble mole, was completed for about 800ft. and the staging for its continuation seaward was advanced a further length of 1200ft. The north quay, which later on will be protected by a transverse arm, is being built and nearly one-half of the structure has been completed to above water level. The curved breakwater on the other side of the harbour was reduced in length under the revised project from 8000ft. to 5100ft., and this length has not yet been reached. There has been some trouble owing to erosion on the outer face of the breakwater where it changes direction from east to north, and it has been necessary to lay an apron of 40-ton concrete blocks on the outer face of the work. Work also proceeded on the conversion of the Dom Pedro Jetty into a solid work to form the inshore portion of the main curved breakwater. The Titan crane, which had been brought from Cape Town for the construction of the north quay, was erected and is now in use.

It is reported that trade depression and some reduction in the volume of shipping using the port resulted in the suspension of all work in connection with the new basin at Table Bay Harbour. The extension of the breakwater was also discontinued. Some of the berths in the new southern basin had, however, already been brought into use before the work was stopped. The extension of the outer breakwater had been carried out for a length of 1200ft. out of the 1500ft. contemplated at the time when work was suspended. A 60-ton floating crane, which left Middlesbrough towards the end of 1931, arrived at Cape Town, and is now in use in the port.

The extension of the south breakwater at Durban, begun in 1929, was completed in April. This short addition to the breakwater, only 300ft. in length, has cost approximately £174,000. The re-equipment of the port proceeded during the year, several new electric cranes being installed, including one having a lifting capacity of 80 tons.

The extension of the pile wharf at the port of Beira in Portuguese East Africa, which was begun in 1930, is now practically completed and the new structure, 1145ft. in length, is being equipped with sheds and cranes. The wharf extension is carried on cast iron screw cylinders, the superstructure and deck being formed of steel sections and troughing covered with concrete. The transit sheds constructed at the rear are carried upon reinforced concrete piles. We published an illustrated description of the port improvement works at Beira in our issue of April 15th last.

THE EAST.

The breakwaters at Haifa, in Palestine, begun in 1929, are expected to be finished during the coming summer. A short illustrated description of the harbour works, estimated to cost about £1,200,000, appeared in our issue of July 1st, 1932. The main or west breakwater, about 1½ miles in length, is practically completed. On the shore side of the sheltered water area land is being reclaimed, along the outer edge of which a wharf is to be constructed, including a deep-water berth, 1400ft. in length, and a quay for lighters. The dredging of the sheltered area is now in progress, most of the material removed from the bed of the harbour being pumped on to the reclaimed area.

At the present time the port of Karachi seems to be the focus of activity for new harbour construction in the Indian Empire. The vast development of agriculture in the Province of Sind, which is expected to follow the completion of the Lloyd barrage at Sukkur and the network of irrigation canals associated with it, has induced the trustees of the Port of Karachi to embark on a far-reaching scheme of port development. The Lloyd Quay on the west side of the main channel is, when completed, to have twelve berths available for the largest ships passing through the Suez Canal. Out of these two berths have already been completed. The quay is in direct railway communication with the system which serves the whole of North-Western India, and Karachi is the only available sea outlet for the produce of the great Province of Sind.

It has been stated that the harbour works at Vizagapatam, which have been in progress for several years, will be completed this year. The harbour is being dredged for vessels of 28½ft. draught. A further stage in the development of the Port of Cochin on the south-west coast of India, was under consideration during the year, and it is reported that work will be begun at an early date.

The Nationalist Government of China appointed in 1931 a Commission to study the project for a deep-water port in Northern China, which originated with the late Dr. Sun Yat Sen. The scheme produced by this Commission provides for the construction of an entirely new port in the Gulf of Pohai (Pechihli), about 70 miles north-east of Taku. As the ultimate cost of the project, to be spread over fifteen years, is apparently estimated to be in the neighbourhood of £15,000,000, the magnitude of the scheme is apparent, and there seems to be little likelihood of its being proceeded with in the present condition of internal affairs in China. The Government of Canton also has an ambitious scheme for building a deep-water harbour at Whampoa in the Canton River, at an expenditure of 45 million dollars.

The floating dock, which was built at Wallsend in 1931 for the Port of Wellington, New Zealand, and arrived there at the end of that year, is now in use and is moored alongside a reinforced concrete wharf constructed for the purpose and to which it is attached by hinged booms. The trials of the floating dock, which has a lifting capacity of 17,000 tons, were carried out in April, 1932.

AMERICA.

We referred a year ago to the decision of the U.S. War Department to modify to some extent the conservancy lines of the Hudson River, so as to permit the construction by the Dock Department of the City of New York and other authorities of new piers longer than any at present available for the largest class of Transatlantic shipping. Three of these piers are now building on the Manhattan water front of the river between Forty-eighth and Fifty-second streets. Work on them was begun in November, 1931, and each is to be 1100ft. in length, 125ft. wide, with 400ft. wide water berths. Early in May one of the 1000ft. piers in the Hudson River at Thirteenth-street, used by the Cunard Company, was destroyed by fire.

The St. Lawrence Waterway project was brought a stage nearer realisation by the signing of a Treaty at Washington on July 18th by the United States Secretary of State and the Canadian Minister. The Treaty binds the two countries to co-operate in the engineering works necessary to make the international portion of the river navigable for large ocean-going ships. A secondary part of the scheme provides for works to generate 2,000,000 H.P. of electric energy for the benefit of both American and Canadian industries. It must be borne in mind that the Treaty signed in July is subject to ratification, alike by the United States Congress and the Dominion Parliament of Canada. It is by no means certain that Congress will ratify the Treaty, and it is probable that the Canadian Parliament will postpone consideration of it until the political situation in the States is in a more settled condition. The scheme is an old one and has been under discussion for many years. Not only international, but also inter-provincial jealousies have hindered an agreement which would make possible the construction of a great waterway connecting the Lakes with the Atlantic. Thus the farmers of Western Canada were more interested in the possibilites of the Hudson Bay route and transportation to the Pacific ports. Montreal feared damage to its prosperity, and railway and shipping interests in the east of the United States have not looked favourably on a project which, if realised, will provide a cheaper alternative route to the trade of the Middle West. In our issue of August 12th, there will be found an account of the project and its principal engineering features. Dredging operations in the St. Lawrence waterway between Lake Ontario and Prescott are being carried on, both in the Canadian and the American waters. It is expected that a channel with a minimum depth of 27ft. will shortly be available from the lake down to Prescott, thus completing one of the links of the future St. Lawrence Waterway.

The Beauharnois power project, which was the subject of parliamentary investigation during 1931, began to function at the beginning of October, when the first hydro-electric plant, aggregating 200,000 H.P. was brought into use. In March the Dominion Government made an Order in Council which settles the scope of the future activities and development of the Beauharnois Corporation. The Government takes over the canal works which will ultimately be one of the links of the continuous deep-water navigation between the Great Lakes and Montreal.

The formal opening of the Welland Ship Canal was performed by the Governor-General of Canada on August 6th, in the presence of Mr. Baldwin and other members of the Ottawa Conference which was meeting at the time, when the s.s. "Lemoyne," carrying 15,900 tons of wheat, passed through the canal. The cost of this great undertaking is now stated to have amounted to 130 million dollars. The present depth of 25ft. in the canal can be increased to 30ft. when the additional depth is required, and there is no doubt that this will be done on or before the completion of the improved St. Lawrence Waterway. The task of making this great canal was begun in 1913. The work was hindered by the war, and now, after nineteen years, there is the means of intercommunication between Lakes Erie and Ontario for the largest ship to be found on any of the great American lakes.

The report of the Royal Commission on Railway and Transport in Canada, issued in October, contains an interesting note on the subject of the competition between waterways and railways. The Commissioners cannot discern that railways have suffered seriously from the competition of water routes, or are likely to be prejudiced by the new Hudson Bay route or the St. Lawrence Waterway.

It is reported that the grain-shipping appliances at the new Hudson Bay port of Churchill were considerably augmented during the year. In the 1931 shipping season five grain spouts only were in use for loading, but, in the following season the conveyor

belts were extended to the whole length of the new wharf and twenty-three spouts were available. It was expected that at least 10,000,000 bushels would be shipped at Churchill during the season. Another link between the Hudson Bay and the railway system of Canada was completed at the end of August, when the new railway of the Northern Ontario system reached Moose Harbour, its terminus in James Bay.

Work proceeded during the year on the port extensions at Wolfe's Cove, Quebec, the first section of which was brought into use during the summer of 1931. The Montreal Harbour Commissioners are, as usual, building new wharves and reconstructing old ones.

Though the import trade of Vancouver suffered severely like other ports by reason of the world depression, it is stated that the grain shipments from the port increased by 14 per cent. over the previous year. The grain storage capacity of the Port of Vancouver is now a little short of 17,000,000 bushels.

A Canadian Royal Commission is investigating the feasibility of a ship canal across the Isthmus of Chignecto, connecting the Bay of Fundy with the Northumberland Strait. The length of the projected canal is about 21 miles.

A year ago we recorded that a large part of the port works at St. John, New Brunswick, was destroyed by fire in June, 1931. The strenuous endeavours of the Harbour Commissioners, assisted by the Dominion Government, restored a large portion of the shipping facilities by the end of the year, and by the end of 1932 practically the whole of the works destroyed had been replaced by new and improved facilities.

The latest reports are that there is little likelihood that the scheme prepared by the Nicaraguan Canal Commission appointed by the United States Government will be proceeded with, which confirms the view indicated in our reference to the matter last year.

The Physical Society's Exhibition.

No. I.

As the Optical Society has recently been amalgamated with the Physical Society of London, the annual Exhibition of scientific instruments and apparatus, held at the Imperial College of Science and Technology, will be known from this year onwards as the Physical Society's Exhibition, but although it has been necessary to make this change in the title, the optical instrument trade will continue to be represented and to display the latest optical goods. All the usual features, such as the series of discourses on scientific subjects and the apprentices' competition in craftsmanship and draughtsmanship, are being retained, and judging from the show which was held from Tuesday to Thursday of last week, the amalgamation of the two Societies will prove beneficial to the Exhibitions.

There are, of course, always many exhibits that have no connection with engineering, and sometimes experimental demonstrations which seem unlikely to lead to anything very practical, but it is probably

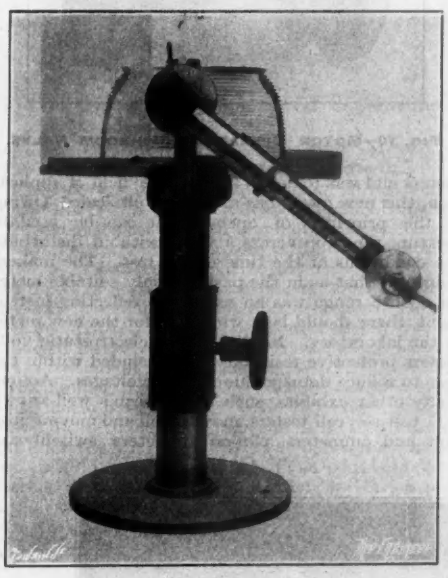


FIG. 1—RAY PATH APPARATUS

true to say that engineers who make a habit of visiting this Exhibition invariably find much to interest them. Even exhibits and demonstrations of a very specialised character often prove fascinating to visitors without expert knowledge. Few, for example, can have failed to be attracted last week by the Marconi valve apparatus for medical and surgical diathermy. In surgical operations special electrodes take the place of the surgeon's scalpel and a high-frequency arc severs the tissue. Similarly, many must have been intensely interested in a demonstration, given by Miss M. D. Waller, designed to show how sound can be produced in bodies by contact with solid carbon dioxide of high density, and in various other curious demonstrations given by other people.

The ray path apparatus shown in Fig. 1 was one of the exhibits of the research laboratories of the General Electric Company, Ltd. The object of the apparatus is to investigate the path of a ray of light, which enters a piece of glassware of a transparent nature, such as a refractor or a silvered glass reflector. Owing to the light being incorrectly deviated or trapped within the glass by reason of faulty design or manufacture of the prisms or flutes in the case of fluted glass reflectors, the performance of such equipment can be seriously impaired, and the apparatus under consideration has been developed to ascertain what is really happening. A sample of the glassware is cut at right angles to the flutes of the prisms under investigation, and the cut surface is ground flat. A piece of plane ground glass is then held against that surface, preferably by adhesive applied at two spots. If, then, a very narrow beam of light, such as the image of a slit, be allowed to fall on the glass and specimen at grazing incidence, the path of the ray both in the air and in the body of the glass, after refraction, reflection, &c., at various surfaces (see Fig. 2) can be observed, since it shows up on the ground surfaces.

The apparatus consists of a table upon which specimens can be placed, as shown in Fig. 1, and a swinging projector mounted in a bearing, so that the ray of light can be considered as radiating at any desired angle from a point in space. Adjustment screws and scales are provided to enable the point from which the ray emanates to occupy the position of the centre of the filament of the lamp used with the reflector under test, or, alternatively, one side or the other of the filament. All kinds of prismatic glassware and

FIG. 2—GLASS SPECIMEN UNDER TEST

reflecting glassware can be tested, and such effects as incorrect prism formation, loss due to internal reflection, &c., can easily be studied. Hence it is possible to observe sources of inefficiency which would otherwise be difficult to discover.

Among other exhibits of the research laboratories of the General Electric Company was the equipment for a lift-levelling system for use with gearless and geared traction lifts. In order to cause a lift car in motion to slow down and finally to stop, it is necessary that certain magnetic relays on the controller governing the speed and direction of motion of the car shall be successively de-energised at precisely the correct distance from the floor. In accordance with this new system, a number of coils are enclosed in a box and mounted on top of the car with vertical slots between the coils. Certain of these coils are energised with alternating current, and the resultant induced voltage in the neighbouring coil is applied to an amplifier unit in such a manner as to cause no current to pass. When the coil passes an iron plate, however, this induced voltage is cut off, and magnetic relays fitted to the main controller successively operate to slow down the lift and stop it at the floor required.

Demonstrations were given, at specified intervals during the Exhibition, of the motion of air currents by the Schlieren method, the organisations responsible for the demonstrations being the British Electrical and Allied Industries Research Association and the research laboratories of the General Electric Company. Primarily, the apparatus used was developed for rendering visible the movement of hot air around electric lamps and fittings, with a view to developing methods of reducing the temperature of rubber insulation, but it may also be employed for showing convection currents rising from radiators or other hot bodies, the flowing of gases, &c.

In accordance with one arrangement, shown in Fig. 3, rays of light from a source P pass through the combination of lenses L and form an image I_1, which becomes the object for a concave mirror M. The mirror forms in turn an image I_2, and the rays of light then pass into a camera C, a lamp fitting F being placed in the convergent beam. A vertical straight edge at S_1 covers half of the image I_1, whilst a second straight edge at S_2, parallel to the image of S_1 at I_2, can be made to move horizontally by means of a screw, so as gradually to reduce the amount of light passing at I_2 into the camera C, which is focussed on the lamp fitting F. Before interposing S_2 the image of the mirror is seen as a bright disc of light on the camera screen, but as the straight edge

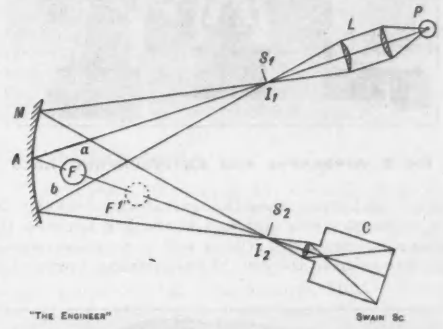


FIG. 3—SCHLIEREN AIR CURRENT APPARATUS

is moved across the image I_2, the disc of light gradually becomes fainter, and finally disappears. When the light is just disappearing the apparatus is in adjustment, and the light passing S_2 is in the form of a very narrow slit. If, however, a small amount of hot air exists at *a*, then the rays of light passing through it will be refracted away from the axis A I_2, and will therefore fall on S_2, and will not enter the camera, with the result that a dark patch will be seen in C. But if there is a small amount of hot air at *b* on the other side of the axis A I_2, the light passing through it will be refracted away from the axis, so as completely to clear S_2, causing a bright patch to appear on the screen of the camera. Thus the convection currents show up bright on one side of the mirror. At the Exhibition the arrangement shown in the diagram was somewhat modified to obtain increased sensitivity, &c., but Fig. 3 serves

FIG. 4—AIR CURRENTS ROUND AN ELECTRIC LAMP

to explain the general principle. The illustration, Fig. 4, shows air currents rising round a 60-watt lamp.

Apparatus for extinguishing arcs between separable electrodes during the rupture of high-power electric circuits and suitable for fitting to most of the commercial types of ordinary plain circuit breakers was shown by the British Electrical and Allied Industries Research Association. In the simplest case shown at A in Fig. 5 an outer container immersed in oil encloses a set of baffle plates with outlets which provide the paths of escape for the arcing products. When the arc is struck in the container gases are evolved and the pressure that is produced drives these products through the outlets and forces the arc into the throats of the outlets, the total escape of the arc from the chamber in the direction of the blast being prevented by the narrowness of the outlets. The apparatus is said to form a very effective arc rupturing device, and in the unit exhibited certain improvements have been embodied with a view to still further improving operation. Six similar units incorporated in a commercial type of breaker showed on test a rupturing

capacity of 750,000 kVA on a highly inductive circuit.

The model shown at B in Fig. 5 was built in 1931 and has been employed in tests up to 22,000 volts with a single break. On several occasions during these

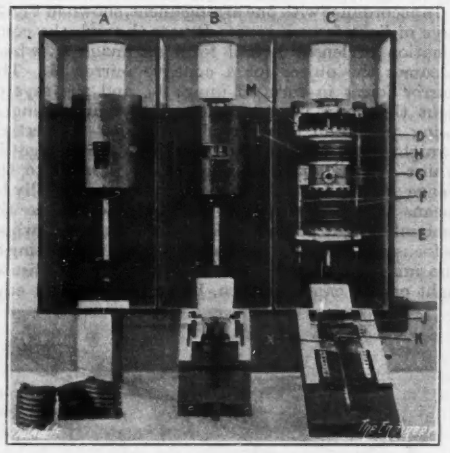


FIG. 5—APPARATUS FOR EXTINGUISHING ARCS

tests a dielectric strength equivalent to 4000 volts per millimetre was obtained in the gap between the separating electrodes within a few micro-seconds of the extinction of the arc. The apparatus operates on

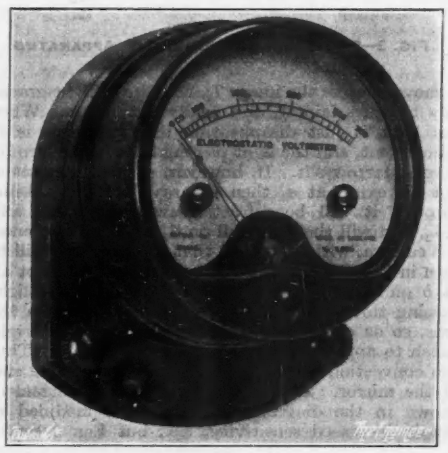


FIG. 6—ELECTROSTATIC VOLTMETER

the principle of the differential hydraulic press, the gas generated by the arc being utilised to compress the oil in the arcing chamber and to force it into and through the arc gap against the pressure therein.

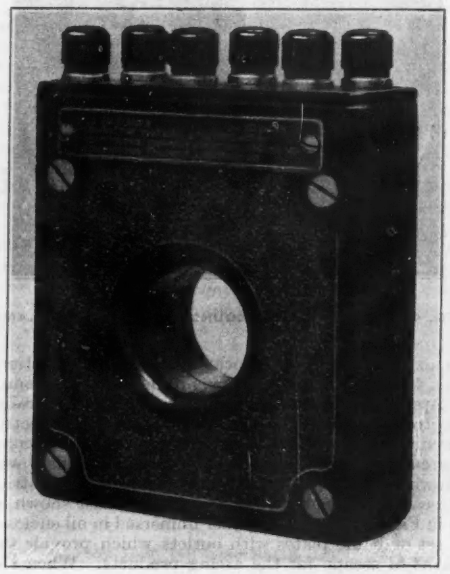


FIG. 7—CURRENT TRANSFORMER

The arc gap is sealed at the zero point in the current alternation and re-ignition is prevented.

The model C is a variation of model B. In the latter bellows are used as shown, and a piston is formed by two plates D and E, connected by the bars F, which slide on guides G on the arcing chamber H, the leather bellows connecting the plates to the arcing chamber in the manner shown. The top hollow fixed contact X is attached to the arcing chamber, which is fixed to the lead-in conductor passing through the top insulator. The pressure set up by arcing acts on the two faces of the plates D and E enclosed by the bellows, and as the upper bellows have a larger mean diameter than the lower bellows the resulting force moves the plates D and E connected to the tie rods F upwards.

FIG. 8—DAMPER OPERATING MOTOR

Oil is thus forced from the lower bellows across the arc and through the passageway formed in the top contact into the top bellows and thus extinguishes the arc. Further movement of the plates D and E relieves the pressure by the top plate moving over the reduced section of the plug J, thus allowing the bellows

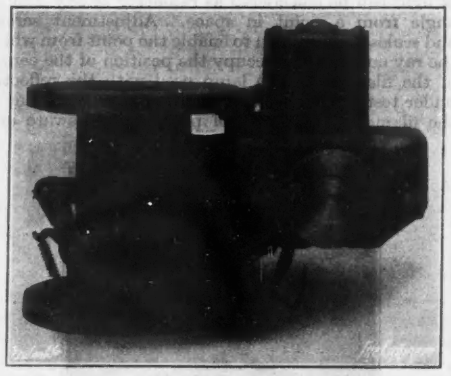


FIG. 9—MOTOR OPERATED BUTTERFLY VALVE

to be returned to their initial position by light springs (not shown) on the lower part of the tie bars F. A copper grid K is fitted above the top contact to minimise the lengthening of the arc, with all currents, whilst still allowing easy passage of the arcing products and oil. An initial movement can be given to the bellows by springs L, which are kept in compression by levers M which are trapped by rods fixed to the lower moving contact. During 1932 a switch of this type with an arc gap of about ½in. was subjected to some eighty tests with progressively increasing current from a modern 10,000 turbo-alternator and ruptured with ease approximately 10,000 R.M.S. ampères at 6600 volts single phase, the amount of oil moved during each operation being about equal to the quantity that can be placed in a teacup. The circuit on which the tests were made was highly inductive, but the switch stood up to the work quite satisfactorily. All the switches shown are covered by patents granted to Mr. E. B. Wedmore, Dr. W. B. Whitney, and Mr. A. M. Cassie, of the British Electrical and Allied Industries Research Association.

One of the most recently developed electrical instruments exhibited by Ferranti Ltd. is the electrostatic voltmeter shown in Fig. 6. Whilst in the past a 100–400-volt instrument was the lowest reading instrument in this firm's range of electrostatic volt-

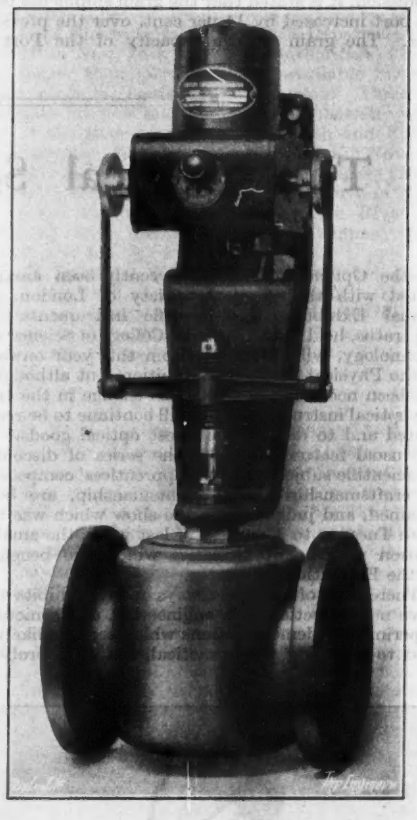


FIG. 10—MOTOR OPERATED MUSHROOM VALVE

meters and was found to have a wide field of application, this new meter has a 50–300-volt scale. Owing to the principles of operation it can be used to measure the drop across a valve without disturbing the conditions at the time of the test. The makers point out that as in the past the only suitable meter for such a range was an expensive reflecting instrument, there should be a wide field for the new meter in the laboratory. In all Ferranti electrostatic voltmeters protective resistances are included within the case to reduce damage due to over-voltages. Among many other exhibits, such as the firm's well-known A.C. test set, cell testers, moving coil and moving iron volt and ammeters, clip-on ammeters, switchboard

FIG. 11—"MEGGER" EARTH TESTER

instruments of various types, a phase rotation indicator, &c., were small current transformers, as shown in Fig. 7, which are primarily intended for use in conjunction with the firm's 2½in. moving iron ammeter and A.C. test set. Currents from 50 milliampères to 200 ampères can be measured with first-grade accuracy.

The standard transformer has a ½-ampère secondary and a self-contained primary with ranges of 25–10 and ½ ampère, whilst in addition a primary may be inserted through the centre aperture to give 50–100 and 200 ampères. The transformer may be used over a frequency range of 20–150 cycles and the accuracy at 50 cycles is said to be within 1 per cent. with a maximum burden of 2 volt-ampères.

In cases in which higher accuracy is required for metering, as when phase angle is important or when higher volt-ampère output is required, the transformer can be fitted with a special core to give closer accuracy and a higher output. Where lower current readings are not essential the self-contained primary winding can be omitted and the transformer may then be fitted with a special secondary to enable its range to be extended up to 500 ampères. As the performance is not materially affected by open

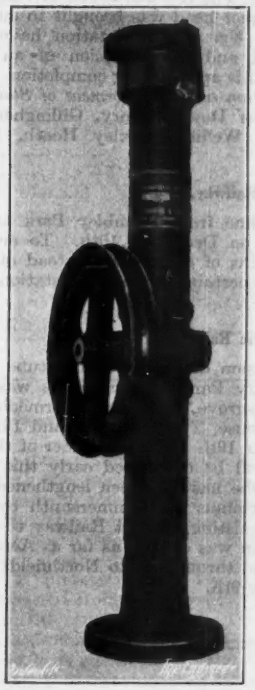


FIG. 12—TRANSMITTER FOR LEVEL INDICATORS

circuiting the secondary winding while on load, a short arc circuiting switch has not been fitted.

The Drayton operating motor (Fig. 8), exhibited by the Drayton Regulator and Instrument Company, is for the automatic control or remote manual control of valves or dampers. In conjunction with suitable switches, it can be applied to the control of solid fuel fired hot water or steam boilers, lever-operated valves in flow mains, gas-fired boilers, calorifiers, oil-fired boilers, &c., and when desired a switch can be embodied in the motor unit for opening and closing an electric circuit in synchronism with the operation of the damper or valve. The unit consists of a fractional horse-power motor with reduction gearing housed in a common casing, and it is so arranged that after the final shaft has made half a revolution, it stops automatically, and when the control device switches over to a second contact, it carries out another half revolution.

On the casing there is a hand switch which renders it possible to open or close the damper or valve, irrespective of the controlling switch, but normally this switch is in the neutral position. The time taken for the final drive to complete half a revolution is 30 seconds, but the time can be varied up to a period of two minutes. A.C. motors are of the shaded pole type, and are consequently devoid of brushes, and like the D.C. machines they are supplied for various voltages. The former machines are also supplied for various frequencies. When it is desired to operate butterfly or mushroom valves (Figs. 9 and 10), the motor is mounted rigidly on the valve body and effective overrunning devices are incorporated in the transmission link, so that in the event of the valve reaching the limit of its travel before the arm has completed its movement, no strain is placed upon the motor or gearing; in fact, it is customary to adjust the transmission so that a slight overrun takes place on each stroke. Motor-operated butterfly valves are arranged so that the maximum opening of the valve can be limited to any desired point, and an indicator is fitted to show the position of the valve.

Evershed and Vignoles, Ltd., showed their Megger insulation testing sets, including their latest "Wee Megger-tester" described in our issue of November

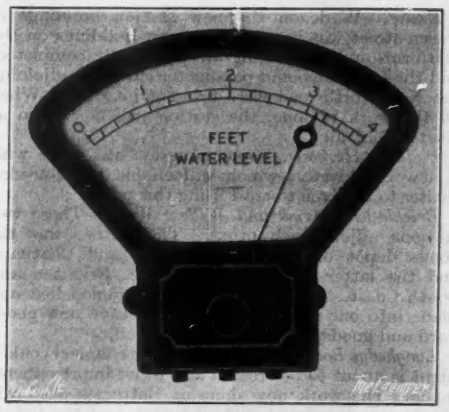


FIG. 13—WATER LEVEL INDICATOR

4th. An instrument exhibited for the first time was a very low-range Megger earth tester—Fig. 11—for geophysical survey by the earth resistivity method. With this instrument investigations can be made of the underlying strata to a depth of some 1500ft., and the readings obtained are said to be unaffected by the resistance of the electrodes used. Another product exhibited for the first time was an arrangement for showing at a distance variations in water levels or variations in the position of such things as gas holders, valves, dampers, &c. The transmitter shown in Fig. 12 has no electrical contacts, for the variation in the electrical pressure applied to the indicator is brought about by a copper sleeve which slides freely over a coil, and so varies its impedance. Where A.C. is available, the coil may, of course, be fed from the mains, but in the case of a D.C. supply, a small motor generator must be employed. For the indication of water levels—Fig. 13—the copper sleeve and float may be made as one unit, the coil enclosed in a stainless steel tube being immersed in the water. Alternatively, the transmitter may be operated by a chain and pulley or other mechanical arrangements. Applications of the system include the indication of boiler water levels, drainage levels and distant indication of pressure, vacuum, draught, &c.

(To be continued.)

British Railways in 1932.

BY the continued courtesy of their civil engineers, we are enabled to give the following report of the engineering activities of the British railways during the past year.

London, Midland and Scottish Railway.

London and Southend Line.—To enable trains to start from and terminate at Laindon, a new down loop is being provided, together with accommodation for stabling two trains. The existing station at Leigh-on-Sea is being replaced by a new passenger and goods station at Hadleigh. The work involves about 13,700 cubic yards of filling for the goods yard and 3000 cubic yards of excavation, the laying of 700 square yards of granite paving, the construction of new station buildings and offices, the driving of about 10,500 lineal feet of concrete piles, and the construction of a new road bridge. A new passenger station is being built at Chalkwell, which is between Leigh-on-Sea and Westcliff. The steel work for the footbridge and booking office substructure has been erected and work is proceeding on the platforms. At Shoeburyness additional carriage siding accommodation is being provided, and alterations are being made to the locomotive depôt. The work involves about 40,000 cubic yards of excavation, the construction of a public road bridge, additions to the existing engine shed, the construction of stores, offices, ash-lifting, and carriage-washing plants. About 9000 cubic yards of excavation have been carried out. The steel work is being erected for the extension of the engine shed.

Dagenham Dock.—A new goods depôt, which necessitates approximately 22,000 cubic yards of filling and 2100 yards of permanent way, is being constructed.

South Kenton.—Work on a new station at this point, which is between North Wembley and Kenton, made progress.

Nuneaton.—The motive power depôt is being remodelled and additional facilities are being provided.

Cheadle Branch.—To avoid the cost of extensive repairs to Cheadle Tunnel, a new deviation line, which will enable the existing tunnel to be closed, is being constructed. The new line, which will be single track about 2¼ miles long, leaves the Cheadle branch just north of Tean Station and joins the original line at Cheadle Station. The existing railway from Tean Station to the north side of the tunnel will be closed, but the remaining length from Cheadle Station to the New Haden Colliery will be used as sidings to serve that colliery. The work involves about 145,000 cubic yards of earthwork and the construction of two bridges over public roads and one over the river Tean.

Bromsgrove and Stoke Works.—The widening from two to four lines was begun and nearly the whole of the 60,000 cubic yards of excavation completed. Two bridges were widened and work on others affected was half done. More than 4000 lineal yards, out of a total of 6300 lineal yards of track, were laid.

Between Stockport and Buxton.—The up and down loops at Dove Holes, mentioned in the review a year ago, were brought into use. Those at Hazel Grove were finished, except at one point.

Besses o' th' Barn.—The construction of a new station to meet the building developments in the Prestwich area made good progress.

Barking and Upminster.—The electrification of this line was referred to in our last issue.

London and North-Eastern.

King's Cross.—The work of reconstructing the locomotive depôt, which has been in hand for some time, was practically completed. The scheme is a comprehensive one, and included the abolition of the round locomotive shed and the conversion of the carriage repair shop into a locomotive shed, the provision of a large turntable, improvements to the sand-drying plant and to the water supply, the introduction of electric power wherever possible, the provision of mechanical coaling plant for locomotives, and numerous other alterations.

The terminus at King's Cross is being entirely resignalled, so that one central signal-box, with an all-electric locking frame, will control the whole yard. The semaphore signals have been replaced by colour light signals. The change-over from manual to electric power operation is a work of considerable magnitude, and is not yet complete.

Peterborough.—The New England locomotive depôt was modernised by the provision of electrically operated coaling plant, the latest type of ashpits, modern rotary sand driers, and other considerable improvements. The permanent way in the yard was almost entirely remodelled and relayed to fit in with these alterations and to reduce unproductive shunting.

Manchester District.—The new down marshalling yard between Dinting and Mottram, described in our Annual Article a year ago, was carried to within 20 per cent. of completion. An electrically operated coaling plant and an ash-handling plant were erected at the Gorton locomotive depôt. The removal of the old coaling stage and its embanked approaches has made room for additional sidings, and simplified working.

Frodingham.—The new locomotive depôt here, described in our last Annual Article, was opened in June. The shed is capable of stabling twenty engines and the whole depôt is built of reinforced concrete.

Liverpool-street.—Special mention must be made of the reconstruction of the superstructure of the western portion of the bridge carrying Primrose-street over the suburban and main lines of railway immediately outside Liverpool-street Station. The main girders are Pratt trusses, 186ft. in length, 27ft. deep. These trusses carry cross girders, spaced 20ft. 9in. apart, and longitudinal road bearers encased in concrete. The street paving rests upon jack arching of pre-cast concrete segments.

Gidea Park and Shenfield Widening.—This is for quadrupling the double line from 14 m. 10 ch. to 20 m. 40 ch., and for constructing 1½ miles of single line for a burrowing junction from the down main line on to the down line of the Southend branch. The work, which includes the reconstruction, extension and improvement of Harold Wood, Brentwood, and Shenfield stations, is well advanced.

Parkeston Quay.—About one-third of the extension of the existing quay was completed. The main features are the lengthening of the existing quay by 1200ft., this being sufficient for berthing three additional vessels; construction of a new passenger station and accommodation for Customs on the quay extension; provision of crane equipment; construction of a branch line to serve the platform on the quay extension; and an extension of the existing goods marshalling yard.

Cambridge.—The locomotive depôt here was enlarged and modernised, the shed being extended by 300ft., so that thirty additional locomotives can be stabled.

Whitemoor.—The new marshalling yard on the down side, to supplement that on the up side opened two years ago, was completed during the year. It has ten reception sidings, with a total capacity of 926 wagons, and forty marshalling sidings, with a total capacity of 3921 wagons. Additional to the two marshalling yards there are a down goods and tranship yard consisting of two reception sidings,

each to hold an eighty-wagon train, and eleven marshalling sidings with a total capacity of 930 wagons. The locomotive depôt was extended and equipped with mechanical coaling plant. Electro-magnetic wagon retarders on the eddy-current rail-brake system were installed in the down marshalling yard. The entering switches of the marshalling sidings are electrically operated. Both switches and retarders are worked and controlled from a single control cabin.

York and Northallerton.—The widening of this portion of railway consisted of two additional lines between Skelton Bridge and Beningbrough; a new down line between Alne and Pilmoor; and two additional lines between Otterington and Northallerton. The contract work was completed and about 80 per cent. of the permanent way laid. The provision of colour-light signalling throughout from York to Northallerton was commenced in July and is well advanced.

Darlington.—The important bridge over Parkgate is, as related in our review a year ago, being reconstructed so as to provide a total width of roadway of 70ft. The eastern section, which carries seven tracks, was completed and about 60 per cent. of the western section is now done.

Between Grosmont and Sleights.—Bridge No. 47 on the Whitby branch suffered considerable damage during abnormal flood in August, 1930, and September, 1931. It is being reconstructed with a single girder span of 82ft. 6in. on the skew and about 80 per cent. was completed.

Coaling Plants in the North-Eastern Area.—The completion is reported of the new mechanical coaling plants, in reinforced concrete, at Leeds, Selby, York, and Hull.

Widening near Montrose.—Details of this work were given in our last Annual Article. The work was completed during the year under review, and makes the whole stretch from Edinburgh to Aberdeen double, with the exception of 2 miles of single track immediately south of Montrose. As on that length there are two long viaducts and considerable rock cutting, doubling would be very costly.

Thornton.—It is hoped to complete the new locomotive depôt here towards next autumn. The main shed is nearly built, while most of the sidings are laid. The engine pits, wet ashpit, turntable, and office buildings are completed, and the building of the mechanical coaling plant is in hand.

Great Western.

Paddington.—The extension of the general offices at the eastern end of the passenger station on the departure side was completed, and has been in use for several months, and the new offices on the arrival side, which are in the form of an eight-storey steel-framed structure, 108ft. high, with artificial stone facings, were practically finished. The new parcels depôt and offices were also completed and brought into occupation. The platforms were extended to give a minimum length of 1000ft., with a maximum of 1240ft., the roof coverings are approaching completion, and the construction of a new footbridge is proceeding. The extension to Bishops-road Station for dealing with a large proportion of the suburban traffic between Paddington and Slough, including extensive alterations to the approaches to the goods yard rendered necessary by these alterations, made progress.

Between Didcot and Swindon.—The increased working facilities here were described in our last Annual Article. The new locomotive depôt at Didcot was opened, and the work at the remaining places approaches completion.

Bristol.—The passenger station at Temple Meads is being remodelled and enlarged in accordance with the particulars given in our Annual Article for 1930. The locomotive depôt is to be improved, and there are to be four lines of way between South Wales Junction and Portishead Branch Junction, a distance of 2½ miles. The bridge over the floating dock was completed during the year and the locomotive depôt is well advanced. The quadrupling will be finished early in the present year. The lines between Filton Junction and Stapleton-road, and between Dr. Day's Junction and South Wales Junction, are also being quadrupled. Tenders will be invited shortly for extensions and alteration of the station buildings.

Westbury and Frome.—The avoiding lines at these places, which are being constructed in order to give a straight run for express passenger and freight trains, were opened for freight traffic on the 1st of the present month, and, after consolidation, will be available for passenger trains. The Westbury deviation is 2½ miles in length, and that at Frome is 2 miles long.

Cogload Junction, Taunton, and Norton Fitzwarren.—The provision of four running lines between these points, a distance of 7¼ miles, was completed during the year.

Norton Fitzwarren and Exminster.—Six of the eight intermediate stations on this length have been converted from two-track to four-track, necessitating new station buildings and bridge reconstruction.

Falmouth Branch.—The Carnon timber viaduct, 766ft. long and of twelve spans, is being replaced by a permanent arched structure, and the work is well advanced. The only remaining timber viaducts on this branch—at College Wood and Ringwell—are to be similarly replaced.

Lapworth and Olton.—The two lines between these points, a distance of 8½ miles, are being converted to four tracks. The work involves alterations to twenty bridges and five stations and approaches completion.

Cardiff, General, Station.—Good progress was made with the remodelling and enlargement of this station. It necessitates the quadrupling of about 1 mile of line, involving construction of new bridges, widening of existing structures, and the erection of a carriage shed at Canton. The carriage shed, quadrupling, and most of the bridges, including the Taff River bridge, was completed.

Docks.—The final instalment of the work necessitated by the 20-ton wagon scheme made good progress. The renewal of the gates at the Roath inner lock, Cardiff, was taken in hand; the lower pair is already in use, and work on the upper pair is well advanced. The construction of additional sidings at Tennant's Wharf, Swansea, approaches completion. The work necessitated the acquisition and filling in of a portion of the Tennant Canal, and the raising of the western end of the Tennant's Wharf, so as to give a continuous length of level quay of 1500ft. with a crane track throughout.

Southern.

Exeter.—Work on the new station buildings in Queen-street was begun. The new buildings on the platforms and the roofing are practically completed, and the footbridge and passimeter entrance adjoining the New North-road were brought into use. When all the work is done, the station will be known as Exeter Central.

Padstow Harbour.—Good progress was made with a new breakwater, which will enable much-needed shelter to be given to craft using this port.

Bricklayer's Arms and Willow Walk.—These two stations adjoin each other. The former was the goods depôt of the South-Eastern and Chatham, and the latter that of the London, Brighton and South Coast. They have now been remodelled and made into one station with an extensive new goods yard and goods shed for outwards traffic.

Longhedge Locomotive Depôt.—A mechanical coaling plant is about to be erected and other improvements made. The work now done at Battersea shed will then be concentrated on Longhedge, and the former shed be closed.

Hither Green.—Work is in hand for an extension of the marshalling yard and the provision of a locomotive depôt.

Haywards Heath.—The station has been entirely reconstructed, and provides two island platforms and a new station building on the down side, with connections to both platforms by means of a subway.

Electrification of the Line to Brighton.—The first section of the extension of electrification to Brighton, which comprised the lines from Coulsdon to Three Bridges, was brought into use on July 17th, and the remainder of the electrification, which extends to Brighton and Worthing, was opened on the 1st of the present month. The scheme represents the addition of 162 miles of electrified track.

The new colour light signalling from Coulsdon to Brighton, including the concentration of the whole of the signalling in the Brighton area in the new signal-box near the main station, was completed on October 16th.

Ryde Pier.—The reconstruction in reinforced concrete of the pier head was brought to an end. The platforms at the terminal station have also been reconstructed and the provision of an additional platform road is approaching completion.

Reconstruction and Improvement of Stations.—This work includes Dover Priory, Gillingham, Eltham (Well Hall), Welling, Bexley Heath, Barnehurst, Redhill.

Metropolitan Railway.

The new line from Wembley Park to Stanmore was opened on December 10th. To accommodate standard trains of eight cars, instead of seven, the platforms at certain of the older stations are being lengthened.

London Electric Railways.

The extension of the Piccadilly tube northwards from Finsbury Park to Cockfosters was opened as far as Arnos-grove, including intermediate stations at Manor House, Turnpike-lane, and Bounds-green, on September 19th. The remainder of the Northern Extension will be completed early this year. The Piccadilly tube has also been lengthened westwards from the terminus at Hammersmith by a duplication of the existing District Railway to Northfields. The extension was opened as far as Acton Town on July 4th, and throughout to Northfields on Monday last, January 9th.

Shipbuilding & Marine Engineering in 1932

No. II. (*conclusion*).*

THE high-pressure geared turbine machinery adopted for large liners gave uniformly good results during the year, but general working practice indicated a possibly greater use of stage heating in future designs, in order to ensure a dry working fluid. Although no particulars are as yet available, we are able to state that the Parsons Marine Steam Turbine Company, Ltd., in collaboration with Mr. John Johnson, is developing a simplified form of single-reduction geared turbine unit for ships of moderate and small powers. There was throughout the year great interest shown in combined exhaust turbine and reciprocating engine units and the improvement of valve gears for triple and quadruple-expansion engines.

Marine Boiler Design.

Although the small number of steamers completed gave little opportunity to test in actual ships new types of steam generating plant, practically no line of development was left untouched. Good experience was gained on the Hamburg-America steamer "Uckermark" with the Siemens Benson critical pressure boiler, and in the "Stassfurt" La Mont water walls with forced circulation were economically employed, a similar arrangement being adopted for the auxiliary boilers of the steamers "Albert Ballin" and "Deutschland." Some of the largest Yarrow boilers constructed and steamed during the year were eight built under licence at Trieste for the Conte di Savoia, which embody the latest Yarrow practice as regards boiler design and superheater and air heater construction. Technical particulars of these boilers are as yet not available, but we are given to understand that they have shown excellent results in service.

Babcock and Wilcox, Ltd., supplied the 375 lb. pressure installation for the "Queen of Bermuda," which will shortly be put into commission. An event of the year was the delivery to the Chatham Dockyard of the first new small tube type Babcock and Wilcox S X boiler for H.M.S. "Guardian." This boiler is now practically completely installed in the vessel. The shore trials carried out at Renfrew demonstrated not only the high efficiency of the boiler, but also its reliability, and the facilities for cleaning both internally and externally, and the renewal of tubes.

One of the most important developments in connection with the cylindrical boiler which took place during the year is the improved boiler design by Mr. John Johnson, in collaboration with James Howden and Co., Ltd., which is illustrated in Fig. 9, and has been introduced in connection with a new system of waste heat recovery, illustrated diagrammatically

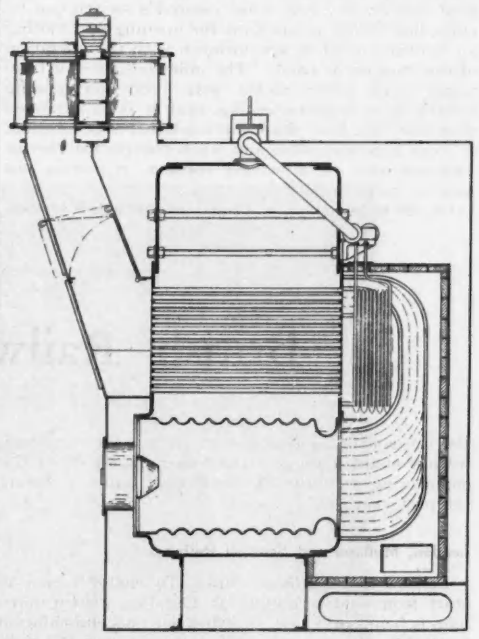


FIG. 9—HOWDEN-JOHNSON MARINE BOILER

by Fig. 10. It will be seen that the new boiler, which is designed for 300 lb. water pressure, differs from the standard marine type in the use of water tubes arranged in a brick-lined, dry-back combustion chamber, which receive radiant heat from the walls. In the centre of the boiler near the top of the chamber the superheater elements, giving a 750 deg. Fah. superheat, are arranged. The whole boiler is enclosed

* No. I. appeared January 6th.

in a metal casing connected to the Howden-Ljungström air heater, enabling the boiler to be jacketed with air at 400 deg. Fah. With air preheating alone it has been found possible to obtain maximum boiler efficiencies of more than 88 per cent. But a further development which enables the utilisation not only of the sensible heat, but also of the latent heat of the moisture in the gases, by washing them and extracting the heat in the washing water, has been proposed and tested by models. With this arrangement the usual arrangement of uptakes is no longer required, and the cooled gases can be directly discharged through the side of the ship, as indicated in Fig. 10. It is claimed that this almost complete utilisation of waste heat will result in an efficiency in the region of 95 per cent. Referring to Fig. 10, the gases leave the boiler A at a temperature of 500 deg. to 550 deg. Fah., and pass through an air preheater B which reduces the temperature to 240 deg. Fah. Thence, they pass into a gas-washing chamber

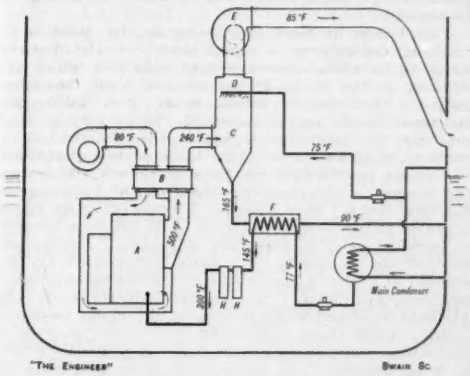


FIG. 10—WASTE HEAT RECOVERY SCHEME

C, where they meet a supply of water from the main condenser discharge, which cleans them and reduces their temperature to about 85 deg. Fah. They then enter the vortex chamber D, where any water which they are carrying is separated and the dry-cooled gases are then finally discharged by the induced draught fan E through a duct leading overboard. The heat recovered from the gases in the preheater is taken up in the usual way by the air for combustion, which is raised in temperature to about 400 deg. Fah., and the heat absorbed by the water in the chambers C and D is transferred in a heat exchanger F to the condensate before it enters the interstage-feed heaters H. In the heat exchanger the condensate is raised in temperature to about 145 deg. Fah., and the water from the gas washer is cooled to about 90 deg. Fah. before being finally discharged under water. The temperatures mentioned above are based on the assumption that the air temperature at the forced draught fan is 80 deg. Fah. and the sea temperature 60 deg. Fah.

Pulverised Fuel Firing.

The use of pulverised coal at sea consolidated its position during 1932. Clarke, Chapman "Resolutor" pulverising plant has now been installed on nine steamers, all of which have been in continuous service since their commissioning and have worked successfully over periods up to four years with very economical results. During the year, two further steamers, for Japan, were equipped, and proposals were made for the equipment of the Johnson marine type water-tube boiler for alternative firing by oil and pulverised fuel. The operation of this boiler on the C.P.R. ships "Princess Helene" and "Empress of Britain," has been completely successful and has resulted in considerable fuel saving. The boilers have been in almost continuous service and have shown themselves to be entirely free from involuntary stoppage. Another interesting Clarke, Chapman development was the decision of the firm to manufacture under licence the Filtrator and Filtrator continuous blow-down system for feed water treatment by means of a colloidal product which, while having no chemical effect on the water, nevertheless, prevents the formation of scale.

A new development of marine pulverised coal firing was that demonstrated by the Duffield Coal Products, Ltd., at its Adderbury Works, near Banbury, at which a standard marine boiler was fired by means of a Rational burner in conjunction with a Gyro pulveriser. The Rational burner delivers the powdered fuel mixed with the carrying air into the furnace in the form of a ribbon, giving a short intense flame. We hope to describe the plant and give test results in an early issue.

Reciprocating Engines and Exhaust Turbines.

Several sets of Bauer-Wach exhaust turbines were completed during the year by William Beardmore and Co., Ltd., and Swan, Hunter and Wigham Richardson, Ltd., and a summary of operating experiences with this type of machinery was given by Mr. R. J. Butler in a paper read before the Institute of Engineers and Shipbuilders in Scotland. Towards the end of the year the announcement was made that David Rowan and Co., Ltd., of Glasgow, had made arrangements with the Götawerken to manufacture its patented exhaust-turbine scheme, in which the exhaust steam from the low-pressure cylinder of the reciprocating engine is utilised to drive a turbine coupled directly to a steam compressor. The compressor draws steam from the high-pressure intermediate cylinder exhaust, and by compressing it raises its pressure and superheats it, after which it is again delivered to an intermediate-pressure cylinder. An economy of 16 to 17 per cent. is claimed for vessels so fitted, and early in the year the first Clyde installation will be completed. A similar plan is that which has been developed by the Wallsend Slipway and Engineering Company, Ltd., in which an exhaust turbine driven compressor is employed to take boiler steam and raise its pressure and superheat before it reaches the high-pressure cylinder of the reciprocating engine.

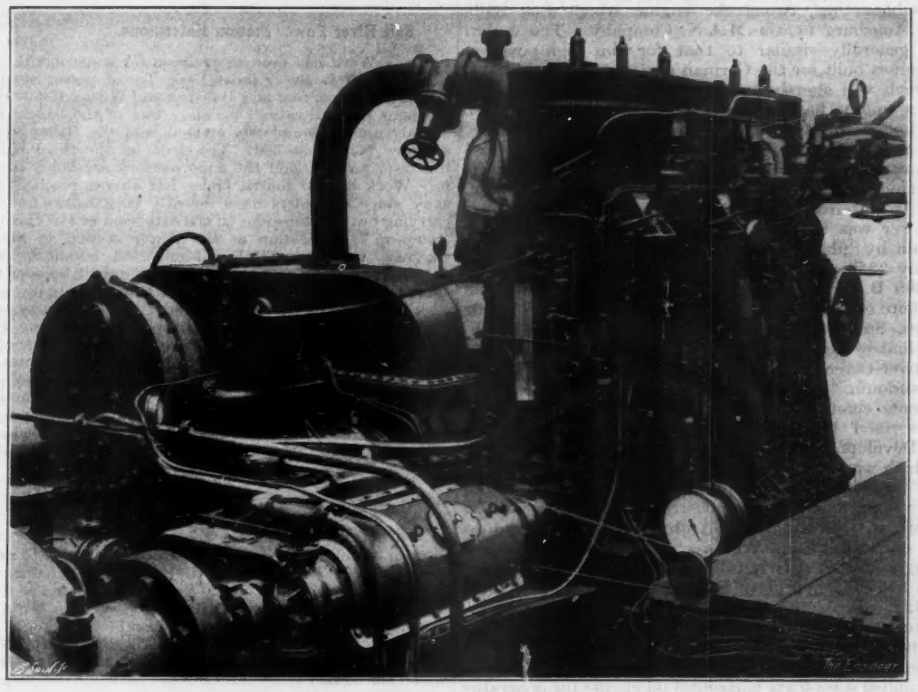


FIG. 11—"WHITE" COMBINED MARINE RECIPROCATING ENGINE AND EXHAUST TURBINE

A noteworthy combined engine and turbine of the year was the White engine, described in our issue of July 29th. This is a combination of a fast-running reciprocating engine and a Parsons exhaust-turbine, driving the same propeller shaft. The arrangement is clearly shown in Fig. 11. Good results were obtained with the trial engine run at the St. Peter's

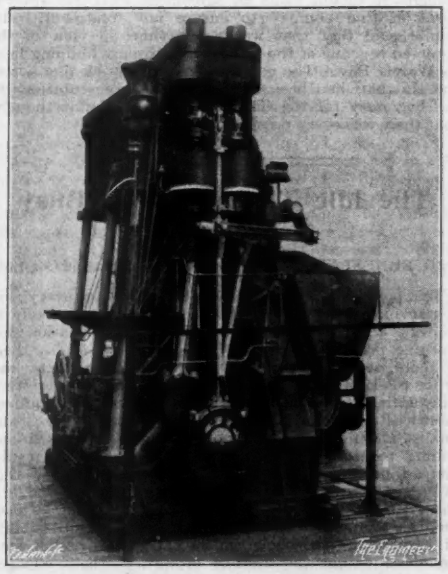


FIG. 12—POPPET VALVE MARINE ENGINE

Works of R. and W. Hawthorn, Leslie and Co., Ltd., and just before the end of the year it was announced that two new steamers for the Moor Line, to be built by the Burntisland Shipbuilding Company, Ltd., are to be equipped with White engines.

Reciprocating Steam Engines.

Owing to the increasing adoption of higher steam pressures and temperatures, attention is being given to valves and their gears, and the poppet valve made some progress last year. In a series of vessels completed and put into service this type of valve was adopted for the steam inlet and exhaust valves of the H.P. cylinder of triple-expansion engines, working at 220 lb. pressure, and steam temperature of 625 deg. Fah. The engines were built by the North-Eastern Marine Engineering Company, Ltd.

Fig. 12 shows the way the gear is fitted to the H.P. cylinder of a normal triple-expansion reciprocating steam engine. It will be seen that the ordinary Stephenson link motion, which has so long been standard practice, is retained, and that all the modifications necessary to fit poppet valves, instead of the usual H.P. piston valve, take place above the H.P. valve spindle. Such a design means the minimum amount of alteration, and makes this type of machinery readily suitable for all classes of cargo vessels.

A further development in the same direction was the Quadropod quadruple-expansion engine, designed by Mr. Maurice S. Gibb and built at the Central Marine Engine Works, West Hartlepool. It was described in THE ENGINEER of July 22nd, 1932, and has been installed in two cargo ships, from which results showing a consumption in regular service of about 1 lb. of good coal per I.H.P. hour, have been obtained. By the use of a single steam receiver, the number of valves required is four less than for a normal quadruple-expansion engine. The Andrews and Cameron cam-operated quadruple opening separate inlet and exhaust slide valves were used with success on the Harrison high-efficiency steamer "Harmatris" and sister vessels, while good results in conjunction with a uniflow low-pressure cylinder were obtained with the converted engines of the Clyde steamer "Annan," which were reconditioned by Alexander Stephen and Son, Ltd., of Linthouse, Glasgow. The difference in the old and new engines represented, we are told, a saving of the order of 40 per cent. on the total fuel used per voyage, including coal used in port. No doubt the use of the Stephen engine will be extended on the basis of the experience which has been gained. During the year Swan, Hunter and Wigham Richardson, Ltd., made arrangements to manufacture under licence the Christiansen and Meyer double-compound semi-uniflow engine, which has been used on the Continent for a wide range of steamers, and is particularly suited for working in conjunction with turbines on the Bauer-Wach principle. The engine has been introduced to British engineers by Mr. W. A. Christianson, and it has already been fitted in nearly forty vessels in sizes from 500 up to 1000 I.H.P. Steam consumptions of the order of 10 lb. per I.H.P. hour have been recorded, and indicate a high economy with no more than a reasonable degree of superheat.

Marine Oil Engine Progress.

Although only three British-built motor ships were completed in 1932, considerable technical development took place, both in this country and abroad, the results of which will, however, only be apparent when new ships are ordered. The total world output of motor vessels was fifty, and their aggregate gross tonnage was over 3½ million gross tons, with well over a quarter of a million indicated horse-power. Holland had the largest output with seven ships completed, whilst Sweden and Denmark followed, each with six ships.

The largest oil engine completed during the year was the eight-cylinder, 22,000 B.H.P., double-acting

two-stroke motor, built by Burmeister and Wain, Ltd., for the Copenhagen Electricity Works. The engine is based on the marine design so successfully adopted in the "Europa" and "Amerika," belonging to the East Asiatic Company, and these engines were described in an article which appeared in our issue of July 15th. An outstanding motor ship of the year was the "Erria," a four-masted passenger and cargo vessel belonging to the same owners, which is equipped with 9400 I.H.P. engines. She has a 16-knot service speed, but on her trials attained a speed of 18 knots, a result hitherto unknown for a cargo ship of her type.

Another high-powered engine of the year was the three-cylinder, 6000 B.H.P., three-cylinder, double-acting, two-stroke engine which was built at Augsburg by the M.A.N. Company. The design is generally similar to that for the high-powered engines built for the German cruiser "Deutschland," which will shortly undergo her official trials. The new engine has a rated output of 2000 B.H.P. per cylinder, and runs at 263 r.p.m. The cylinder diameter is 650 mm. and the stroke 950 mm., and the fuel consumption is stated to be 0·34 lb. per B.H.P.-hour, excluding the power required for the scavenge blower.

An interesting Continental engine also of high power was the light engine of welded construction built by Sulzer Bros., of Winterthur, with a weight of only 22 lb per B.H.P. It is a three-cylinder unit of 6400 B.H.P. designed output at 267 r.p.m., and has a bore of 680 mm. with a stroke of 940 mm. Another new Sulzer engine was a 8500 B.H.P., twelve-cylinder engine, one of two units built for the 24-knot Dover-Ostend cross-Channel motor vessel "Prince Baudouin." These and other important developments connected with oil engine manufacture were described by Mr. Robert Sulzer in a paper on "Developments in Diesel Engine Construction," which was read on December 6th before the Institute of Engineers and Shipbuilders in Scotland. Most of the principal engines constructed for motor vessels, both in this country and abroad, were referred to in our last article. We have to record a new Mirrlees engine which was installed in the tug "Crowstone," and described in THE ENGINEER of November 25th, 1932. Both the National Gas Engine Company, Ltd., and Crossley Brothers, Ltd., interested themselves during the year in new marine engines, while the Premier Gas Engine Company, Ltd., of Sandiacre, supplied a *vis-à-vis* horizontal oil engine for generator driving, which will be used for the electric propulsion of a Chinese river tug. This was described in our issue of December 30th. Several noteworthy engines were built by W. H. Allen, Sons and Co., Ltd., incorporating new marine designs, to which we shall refer in a later issue.

South African Engineering Notes

(*By our South African Correspondent.*)

Beira Harbour Improvement.

THE improvements made in the port facilities at Beira were approved by the Portuguese Colonial Minister on his recent tour of Portuguese East Africa. Up to a year or two ago the anchorages in the stream were extremely unsafe, and if stormy weather was imminent, it was necessary to keep up a full head of steam. There are now eight fixed moorings to which ships up to 12,000 tons gross can be made fast in any weather, while the first of a number of deep-water berths on the left bank of the Pungwe River has now been completed. It has a length of 520ft., and an alongside depth of 27ft. at low water of spring tides, while the cargo-handling equipment comprises one 6-ton and three 3-ton electric cranes. The authorities are now busy upon two additional wharves which will extend to the newly lengthened arm of the lighter wharves in the Chivere Creek, and with the concomitant sidings and transit sheds will create a compact goods-handling area, comparing very favourably with that of any other port on the East African coast. During the past six months there has been a remarkable increase in the number of passengers embarking at Beira, owing to the vastly improved conditions in the port.

Durban's Electrical Engineer.

The Durban Town Council has selected Mr. S. A. West, local manager of the Electricity Supply Commission at Colenso, as the new borough electrical engineer, to succeed Mr. J. Roberts, who retires shortly. Mr. West, who is forty-five years of age, has had experience in London and at various stations of the Victoria Falls Power Company, and with the Pretoria Cement Company. The salary is £1355, rising to £1581 per annum.

The Greater Rand.

Presuming that the discoveries made by the engineers and prospectors of the New Consolidated Gold Fields, Ltd., are confirmed, then the area of the Witwatersrand goldfield has been roughly doubled. A new company with a capital of £500,000 has now been formed to test the area, extending 40 miles in a south-westerly direction, and including the practically unsurveyed gap between Randfontein and Frederikstad and to the Mooi River. The discovery that the Main Reef series extends all that distance has been made by the geologists, including Dr. Reinecke, and mining engineers of the Goldfields Company, using geophysical methods. The Main Reef series has not been directly proved, but certain magnetic layers which always accompany the Main Reef series have been traced by the use of an instrument which locates the magnetic bodies, or "markers," and differentiates between them by the different strengths of the magnetic effects set up. What it is now sought to do is to put down a large number of bore-holes along the areas to depths of 1500ft. to 2500ft. These should locate some of the members of the series and assays will decide as to the ore containing gold in payable quantities. If, as seems most probable, gold is found in payable quantities, then the new company will proceed to exercise the options it now acquires from the New Consolidated Goldfields, Ltd., and proceed to open up mines. The New Consolidated Goldfields has reserved for itself the controlling interest of over 50 per cent. of the shares in the new company. If the discoveries are confirmed, great mining activity may be expected all along this area as soon as the Union abandons the gold standard or Britain returns to it, as either course would make it possible to obtain the necessary capital sums without loss through exchange.

Salt River Power Station Extensions.

Work has been in progress for some months at the E.S.C. Salt River (near Cape Town) power station on the erection of four new Babcock and Wilcox 100,000 lb. per hour (normal rating) boilers. Two of the boilers are already almost completely erected, and the Bailey walls are now being installed. The drum of the third boiler has been put up, and the tube sections are being fitted in. Work on the fourth boiler has almost reached the same stage. Tenders have recently been called for the carrying out of alterations to the extension of the existing "step-up" sub-station at the power station to house six new iron-clad 33-kV oil-immersed circuit-breaker panels, comprising two bus couplers, a circuit breaker for the new 20,000-kW generator, and three panels for new 33-kV feeders to the Corporation's transmission system and for housing all future generators and feeders. The switchboard at present installed in this sub-station controls the 33-kV supply to the rural overhead transmission system and to the railway traction sub-stations, the supply having been "stepped up" from 11,000 volts through three 6000-kVA transformers. Work has just been started on the foundations for the new 33-kV, 20,000-kW turbo-alternator, which is being supplied and installed by C. A. Parsons and Co., Ltd.

Germiston Sewerage.

After considerable delay, the Germiston Town Council has obtained the Administrator's sanction to raise a loan of £50,000 to proceed with its sewerage scheme. It is understood that the £50,000 loan will be floated as soon as possible, and that work may be expected to begin at any time. A large number of unemployed should be absorbed. In the meantime, the Council will proceed with the scheme on the strength of a sum of £22,000, which has earned £1000 interest—set aside for the purpose some time ago.

Rhodesia's Railway Outlets.

At the Rhodesian Party Congress recently, the Premier of Southern Rhodesia, Mr. H. U. Moffat, in replying to a debate on the question of a port on the West Coast, and a connecting strip of territory, said that while in London he had discussed the matter with the British Government, but he was not given much encouragement. If Rhodesia wanted a portion of seaboard on either the West or East Coast, it would have to give something in return, and that might be impossible. It could not consider building a port on a foreign coast after the experience of the port now serving Rhodesia. The grave disability of Rhodesia being at the mercy of a foreign port was fully recognised. When the day came that it had connected its railway with that of South-West Africa, he thought it should make an agreement with the Government of that country to ensure fair treatment. Mr. Moffat said that that was not a time, in view of the depleted revenue of the railways, to discuss building lines to Walvis Bay. The construction of a stock line across the Kalahari had been the subject of representations to the Secretary for the Colonies, and Mr. Moffat thought that there was every possibility of its being built.

The Idle Thoughts of a Busy Fellow.*

By G. ERNEST WELLS (a Director, Edgar Allen and Co., Ltd.)

THE position in steel foundries to-day is that everybody is starving for work, and as far as I can see, is likely to continue to do so. Comparing the general situation pre-war and post-war, it should be realised that to-day there is more steel foundry area available than there was prior to 1914. In addition, equipment has improved substantially, so that on a given area may be produced more castings than on the same space previously; and finally, and most important of all, the moulder is to-day willing to work under systems of payment by results instead of on datal rates, with the consequence that in many cases his output may easily be doubled. If these fundamental facts are realised, it should be easy for the simplest mind to appreciate the impossibility of employing the whole capacity of the existing steel foundries within the lifetime of any of those engaged in the industry to-day, unless one is to envisage another world war, which would be the end of all things. It would appear, then, absolutely essential that steps should be taken to reduce capacity. This *can* be done by the operation of the law of the survival of the fittest, and I have been accused by many friends and competitors of recommending this process; but I take this opportunity of categorically denying ever having done so. I have enough sense to realise that an individual may go into a free fight and come out alive, but at the same time may be permanently maimed as the result of the encounter. That is exactly what would happen if the foundries embarked on a scheme of cutting one another's throats in an effort to eliminate the unfit. My own definite view is that some better way could and should be found in order to get us out of our present dilemma.

In my judgment there are a number of steel foundries in this country which should close their doors, and, speaking as an individual, I think it is only fair that they should be compensated for doing so by means of a fund raised by those who continued in operation. I appreciate the difficulties of the proposal, but I am not prepared to admit that they are insuperable. Other industries have dealt with a similar situation successfully, and in my opinion a steel founder has at least as much common sense as a miller. What I do feel is that unless the industry itself can devise a means by which it can operate on economic lines, pressure will be brought to bear on it from outside sources. The tariffs were imposed on imported steel castings with the object of keeping them out of this country altogether, but it does not seem rational to demand that those tariffs should be maintained or extended if they do not serve the purpose of putting the steel foundries on their feet. I am aware that in the minds of some of my competitors the view is strongly held that we should band together and refuse to sell at figures below cost of production. This proposal leaves me quite cold, as I am satisfied that costs of production cannot be brought down to an economic basis in any plant which is not occupied to a reasonable percentage of its capacity.

This brings us back once more to the question of reducing capacity to a figure nearer to the demand likely to be made upon the steel foundries, which are working to-day at 25–30 per cent. of their maximum output. Government action, apart from taking off the tariff, would appear impossible, but it may be that one day the people who provide the wherewithal to carry on will kick. I am of far too humble a disposition to presume to offer advice to those gentlemen who control the finances of the country; but I can at least express the view that if I were a banker, I would prefer six sound accounts to twelve doubtful ones. I do not know enough of banking policy to make any suggestion; but it may be that the prosperity of a bank is measured by the amount of money it has on loan uncovered by any realisable security. What I mean is that a house which cost £1000 to build and which is situated in a highly populous district where there is a demand for houses may be a real asset. An exactly similar house in a district which is being deserted, and where there is no possibility of letting it, may be an actual liability. In the same way, if a works that had fixed assets in the form of buildings, plant and machinery, were engaged in production to a reasonable percentage of its possible output, its fixed assets might be a valuable asset on which to advance working capital. If, however, that same works is only occupied to 25 or 30 per cent. of its possible output, the security provided by its fixed assets would be very small. It seems to me that the security which the works provides is exactly equal to its market value, and there are very few people to-day who would be willing to buy a steel foundry at a figure above its value for breaking-up purposes.

As far as I can see, my remarks on the steel foundry situation apply with equal force to most other branches of the steel industry. Everywhere in the country we see steel plant which is not at work, and there does not appear to be the slightest prospect of its ever again being in full operation. During the pre-war period expansion went on normally, in accordance with the increase of the order books of each individual industry. The war saw further and vast increases, and even during the immediate post-war period extensions were carried out. The expansion was abnormal, and my own view is that a corresponding contraction will have to take place, preferably by artificial means contrived on common sense lines. The alternative is a fight to the finish with the prospect of many of the survivors being maimed.

* From the *Edgar Allen News*.

CAST IRON REPAIRS IN CHINA.*

WHILE prowling Hankow's narrow streets a little later, I happened to see a curious method of repairing one of these cast iron pans by the use of melted cast iron used as a solder applied by the workman's fingers protected by thick woollen pads similar to the "tinker's dam" used by our plumbers. The workman was an itinerant tinker who carried his whole equipment suspended from the two ends of a toting pole.

Mrs. Chin had had the misfortune to knock a hole in the bottom of her best cast iron cooking pan, just when she was in a hurry, too. Luck was with her though, for soon the travelling tinker came along the narrow lane they call a street there, announcing his advent by the peculiar rattle he carried. He unloaded his tools from the baskets he carried on the ends of his toting pole and started a charcoal fire in a little clay stove, on which he placed a crucible about the size of a coffee cup. In the crucible he placed broken fragments of cast iron and proceeded to melt them. To get a sufficiently hot fire he used a blower made of a section of bamboo, about 3in. in diameter, with a plunger and valves so arranged that he got a blast on both the forward and backward stroke, using his foot as motive power. While the iron was melting he broke off the jagged edges of the hole and fitted another piece of cast iron, apparently a part of another old pan, to fit the hole. He then propped the pan firmly in a position where he could put one hand above the broken place and the other below. When the iron was melted in the crucible he put woollen pads on his fingers, and, taking a few drops of melted iron in a little forged iron spoon, placed it on the joint of the patch and the pan and pinched the drops flat like so much putty. A few spots like this held the patch in place, and then he went all around the joint, making a fairly smooth and even job, and the pan was as good as new, to the evident relief and satisfaction of Mrs. Chin, as shown by the pleased look on her face. The whole operation took perhaps half an hour, but what is time to such patient people? The cost? Not more than 3 cents.

A LUMBER company of British Colombia has found that by converting its engines from oil to coal burning economies ranging from 17 to 35 per cent. can be effected.

* From an article by Frank A. Foster in the *Worcester Polytechnic Gazette* (November).

Railway and Road Matters.

A BEARING mixture which is reported to have given very good results with the nitralloy steel locomotive crank pins mentioned in this column on November 11th last, is made up of copper 80, nickel 5·5, tin 11·5, and zinc 3. In addition to showing very little wear, bearings of this composition have proved economical in lubricating oil.

THE death of ex-President Calvin Coolidge calls for mention in this column, inasmuch as he was the Chairman of what is now known as the National Transportation Committee. As we related on October 7th last, the banks, insurance companies and other institutions which have large sums invested in the railways of the United States, secured five distinguished and eminently practical men to serve as a committee to analyse the present plight of the companies, and to devise a plan for rescuing them from that grave situation.

THE Ministry of Transport Tramways Return has recently been issued; it is for the year ended December 31st, 1931, for tramway companies, and ended on March 31st, 1932, for corporations. Under every heading, when compared with the previous twelve months, a decrease is reported. The gross receipts were down by 6·97 per cent. expenditure 5·60 per cent., net receipts 12·82 per cent., passenger journeys 6·53 per cent., and car miles 4·95 per cent. There was, though, an increase in a subsidiary heading; the number of passenger journeys made by trackless trolleys increased by 20·50 per cent.

THE Ministry of Transport railway statistics for September last, mentioned herein on December 30th, also gave the results for the nine months ended on September 30th. These show that, compared with the corresponding period of 1931, the number of passenger journeys decreased by 3·8 per cent., and the receipts from passengers by 7·2 per cent. Receipts from all forms of passenger traffic fell by 6·6 per cent. The tonnage of freight traffic was reduced by 7·5 per cent., and the freight train receipts by 10·7 per cent. Merchandise was responsible for a drop of 9·8 per cent. in tonnage, and of 11·6 per cent. in receipts.

THE *Great Western Railway Magazine* for January says, on the subject of carriage cleaning plant, that, for some time past, when building new carriages, endeavours were made to have the exteriors as free as possible from projections, both to reduce the wind resistance and to facilitate cleaning. A sufficient number of such vehicles are now in service to warrant the trial of another machine for cleaning them, and one has just been brought into use fitted with revolving drums equipped with wet leathers. It is hoped that this will overcome the chief objections to the former machines, which employed powerful jets of water and caused some damage through the penetration of the water.

IN the immediate outskirts of York, in the Scarborough direction, there is a light railway which was built by a landowner in order to give his tenants means for the cheap transport of farm produce, bricks and stores. That is the Sand Hutton Light Railway, 7 miles long, of 18in. gauge, and joining the London and North-Eastern at Warthill. The prime mover in the concern was Sir Robert Walker, of Sand Hutton Hall, who got a Light Railway Order in 1920, and the line was opened in April, 1922, and passenger facilities were added in October, 1924. The closing down of some brickworks, coupled with the acute agricultural depression and the competition of road traffic, has, however, led to the abandonment of the railway.

THE shoes carried by the Great Western locomotives that are equipped for automatic train control are liable to foul the rails conveying the traction current on those lines in the London area that are equipped for electric traction. In connection with the equipment of further engines with A.T.C. it was necessary to devise a scheme for clipping up the shoes on locomotives working to the electrified lines and for resetting the shoes on returning from those lines. The apparatus for this was designed and manufactured at the signal works at Reading. Experiments are being carried out with an amended type of cab apparatus, designed to avoid the necessity of an engine battery, and two locomotives will shortly be equipped with this appliance for extended trials.

THE traffic returns for the fifty-first week of last year gave very satisfactory and, in view of past events, unusual results. Each of the four grouped companies, except the L. and N.E.R., which showed a decrease of £4000, had an increase in its passenger traffic, when compared with the corresponding week of 1931, whilst all reported increases in goods and mineral traffic. As a consequence the week's total results were :—Great Western, an increase of £82,000; London, Midland and Scottish, £141,000; London and North-Eastern, £95,000; Southern, £54,000. The fifty-second week, however, told a different story, as no company had an increase in any branch and the year ended with the following reported decreases :—G.W., £2,446,000; L.M.S., £5,021,000; L.N.E., £4,637,000; Southern, £1,593,000.

OUR esteemed occasional correspondent, Mr. J. G. H. Warren, in a letter to *The Times* of January 7th, utters a word of warning to those who, carried away by the idea of the lines from London to Brighton and Worthing being electrically operated and run over by express trains at high speeds, imagine that electrification as a substitute for the steam locomotive is a success. Mr. Warren says that electricity is not a prime mover like the steam engine; it is a means of transmitting power, often of great service and economical, sometimes the reverse. It has not yet been proved that it can produce a horse-power at the draw-bar at less cost than can the steam locomotive. Electrification of railways is adding to the immense liabilities into which the nation has been led by the slogans "Electricity" and "Oil," respectively or in combination. Concluding, Mr. Warren asks: "Does the public realise the strategic price paid by the Navy for the convenience of oil; or the increased commitments of the Army; or the price paid in unemployment in the coal-fields? Let it think twice before it is persuaded to scrap its faithful servant, the steam locomotive."

Notes and Memoranda.

IN the United States 16·4 per cent. of the popluation use telephones, in Canada 13·15, in Germany 5·0 per cent., in Great Britain 4·3 per cent., and in France 2·8 per cent.

THE use of clean hot ferric-chloride for pickling aluminium has been found in the laboratories of Leon Guillet, of Paris, to be superior to any other reagent used heretofore.

THE latest reports from the National Physical Laboratory show that steel coated by dipping it in lanoline is immune from rusting for at least three years. The addition of wax is not recommended, but white spirit, or naphtha, may be used.

WHILE a certain amount of vapour is emitted from the creosote-propelled omnibus, it is, says Mr. J. S. D. Moffat, of Salford, much less objectionable, and does not pervade the atmosphere as much as that of either the oil fuel omnibus or the ordinary petrol vehicle. Further, it disperses as quickly as steam vapour.

THERE is a quaint article in the *Electrical World*, of New York, dated December 17th, by Messrs. Wilkes and Marbury, which deals with the Rankine process of pumping heat into buildings from the atmosphere. It is based on experiments carried out by the Westinghouse Electric Company and contains quite a lot of information.

ANOTHER result of the ingenuity of the engineer, as expressed by *Tin* :—"Canned fruits and vegetables are invariably the pick of the crop. They are promptly canned when they are at their very best, and they remain in that condition, unchanged and absolutely fresh, until they are served on the table. They cannot help being superior to 'fresh' out-of-season fruits or vegetables, which are usually gathered before they are ripe, and slowly decay into an appearance of ripeness during transport from one part of the world to another."

THE "Sparkograph," an instrument which has recently been introduced in Paris, is described in the *Electrical Review*. It makes a record by means of sparks between the point of the needle of a galvanometer and a fixed plate. The spark perforates specially prepared paper and makes a black mark. The registration is thus made without friction between the needle of the galvanometer and the paper, and consequently it is possible to employ an extremely sensitive galvanometer without recourse to photograpic devices, the registrations of which do not become visible simultaneously with their production.

A RECENT issue of *Steel* states that railways and car builders are considering the use of chromium-manganese-silicon steel as a means of reducing the weight of cars. This steel contains 1·20 per cent. manganese, 0·50 chromium, and 0·75 silicon. In the rolled condition it has about 45 tons tensile strength, 27 tons yield point, and 22·5 proportional limit. It is readily welded, and is now being produced commercially in the form of shapes, plates, tubing and bars. Welded cars, built of this steel, would represent a saving of about 40 per cent. in weight, thus cutting down materially on the non-revenue load.

THE development of reinforced brick masonry dates from the year 1813, when Sir Marc I. Brunel proposed the use of this method for strengthening a chimney under construction, and later, in 1825, he used the method in the construction of two brick shafts, built in connection with the Thames River Tunnel, which shafts are still in use. A few years later he built a brick masonry structure consisting of two cantilever half-arches, constructed without the use of centering. Colonel Pasley, in 1837, conducted a series of tests on reinforced brick masonry beams, and in 1851 at the Crystal Palace Exhibition, London, further tests were conducted.

RESEARCH engineers of the Owens-Illinois Glass Company, of America, are studying a small house built entirely of glass brick, produced from silica sand. Great development is expected in this direction. Large oil companies have been interested in the experiments, and may erect filling stations and retail stores of the glass brick in solid or mixed colours to attract attention during the day or at night when they are lighted. In addition, the glass bricks are expected to be used in many buildings for roofs and the upper walls to provide natural daylight. The bricks are made both solid and hollow, the latter type providing insulation as well as transmitting light.

FULL-SCALE experiments have been made in Germany on the production of a new type of cement, in which the magnesia content is considerably above that allowed by the German Standard Specification for Portland Cement. The report is summarised in Abstract No. 2022, in the November issue of *Building Science Abstracts*, and shows that two cements with 5 and 25 per cent. magnesia respectively have been produced from raw mixes of marl and dolomitic limestone, and of clay, dolomitic limestone and a small proportion of burned pyrites. The results of standard tests on the cements are quoted to demonstrate them to be equivalent to good rapid-hardening Portland cements. No trace of unsoundness was observed. The name "Magnesite Portland" has been suggested for this cement.

TO-DAY, says the *Earth Mover*, of Aurora, Illinois, the tendency toward larger loading units in the Mesabi iron ore district has reversed itself and is now back toward 4-yard and 5-yard shovels. Caterpillar traction, the practicability of which was demonstrated in the war, together with the electric drive and improvements in alloy steels, has produced a compact, powerful, fast, light-weight, excavating machine that is considered more economical than the larger, long-swing, slow-moving shovel. It is much more flexible, faster, more economical to operate, cheaper in first costs, more mobile and can be used for either stripping or loading. It works against a much lower face, with less chance of slides, and, it is claimed, will load as much material in the course of a year as the larger shovel. Incidentally, the repair or maintenance cost of the electric shovels is very much lower than that of steam shovels. For these reasons 4-yard and 5-yard shovels, electrically operated, are the most popular shovels on the Range at the present time.

Miscellanea.

THE Low Moor Iron Company has restarted its two blast-furnaces.

THE Feldmuhle A.G. of Switzerland is making arrangements for the manufacture of viscose transparent paper.

A LARGE motor cargo ship is to be laid down, for open sale, by Swan, Hunter and Wigham Richardson, of Wallsend.

A CONTINUOUS wire rod mill is being constructed at Irlam, Lancashire, for the supply of the Rylands and Whitecross wire-drawing mills.

LAST year 70,162 passengers flew in and out of Croydon aerodrome, compared with 44,944 in 1931. About 60 per cent. travelled by Imperial Airways.

A GIRDER weighing 42 tons from Monmouth was unloaded at Acton on its way to the railway bridge over the new by-pass road at Alperton, Middlesex.

THE bridge which is to be built over the river Towy at Carmarthen is to be of steel, not reinforced concrete, as was suggested at one time. It will cost about £26,800.

THE Government of Chile has made a law that omnibuses should be converted from petrol fuel to suction gas made from charcoal at the rate of twenty vehicles per week.

DURING last year the average flow of the Thames over Teddington weir was 1600 million gallons a day. The total rainfall in the watershed was 28·62in., which is above the average.

THE area of the floor space at the Birmingham Section of the British Industries Fair this year will be 250,000 square feet. The Fair opens on February 20th, and will continue until March 3rd.

THE Ministry of Health is to hold a conference with representatives of Kent and Essex County Councils at the end of the month on the proposed Thames tunnel between Dartford and Purfleet.

AERIAL surveying is being increasingly used in South Africa in connection with the development of gold mines. The latest areas to be so attacked are the Far East Rand and the Pilgrim's Rest district.

IT is stated in Italy that the new Italian cruiser "Armando Diaz" has given such satisfactory results during a series of speed and fuel consumption trials that she will probably be able to attain if not exceed 42 knots.

AN important improvement being carried out on Vancouver's waterfront is the extension of the Lapointe Pier, which, on completion, will have a length of 1100ft. and will provide berths for five of the largest freighters afloat.

THE Russian People's Commissariat of Economy is proposing to establish two experimental lines of trolley omnibuses in Moscow and Leningrad during 1933. The omnibuses used in this experiment will be imported from abroad.

IT is reported that the Kai Cheng Chemical Company, a Chinese corporation with a capital of about £75,000, has under construction a sulphuric acid plant with a capacity of 6000 tons a year, and proposes also to manufacture nitric and hydrochloric acids.

A NEW German salvage boat for airplanes is nearly completed, says *Engineering Progress*. It is to be employed on salvage work along the German coast and is designed for accommodating two seaplanes. Being equipped with two 250 H.P. Diesel engines, it will have a speed of over 12 knots.

A CHILLED cast iron plate roll weighing 35 tons was recently made for the British (Guest, Keen, Baldwins) Iron and Steel Company, of Port Talbot, by R. B. Tennent, Ltd., of Coatbridge. It is 22ft. 2½in. long overall, and has a barrel 12ft. 7½in by 3ft. 7½in. in diameter. It required the melting of 50 tons of cold blast iron and was cast in a flask weighing 82 tons.

THE Metropolitan Water District of Southern California has awarded the contract for the San Jacinto tunnel, 12·7 miles long, to the Metropolitan Engineering Corporation, Los Angeles, for 7,331,815 dollars. The tunnel is the first contract let for the building of the Colorado River Aqueduct, which will be 240·52 miles long and will contain 84·88 miles of tunnel. It is a 16ft. horseshoe section, and will be concrete-lined throughout.

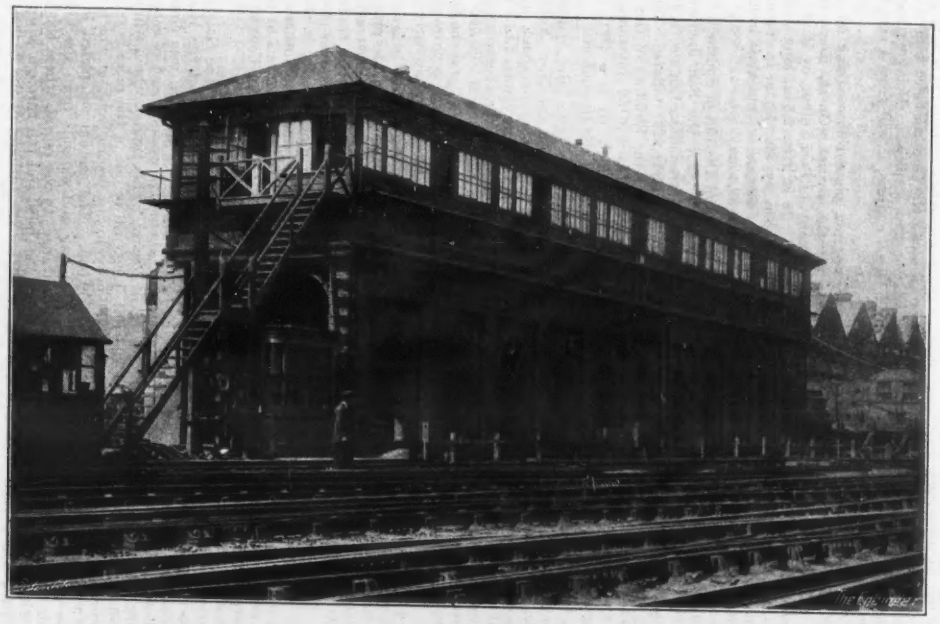
ON Wednesday, January 4th, the Cunard liner "Aquitania," left Southampton for New York after a complete refitting and machinery overhaul, which had been carried out by John I. Thornycroft, Ltd. The work on the accommodation included the construction of new outside bedrooms and a theatre and cinema. On her arrival at New York the "Aquitania" was the first ship to use the new Cunard piers which have been recently completed to replace those destroyed by fire early last year.

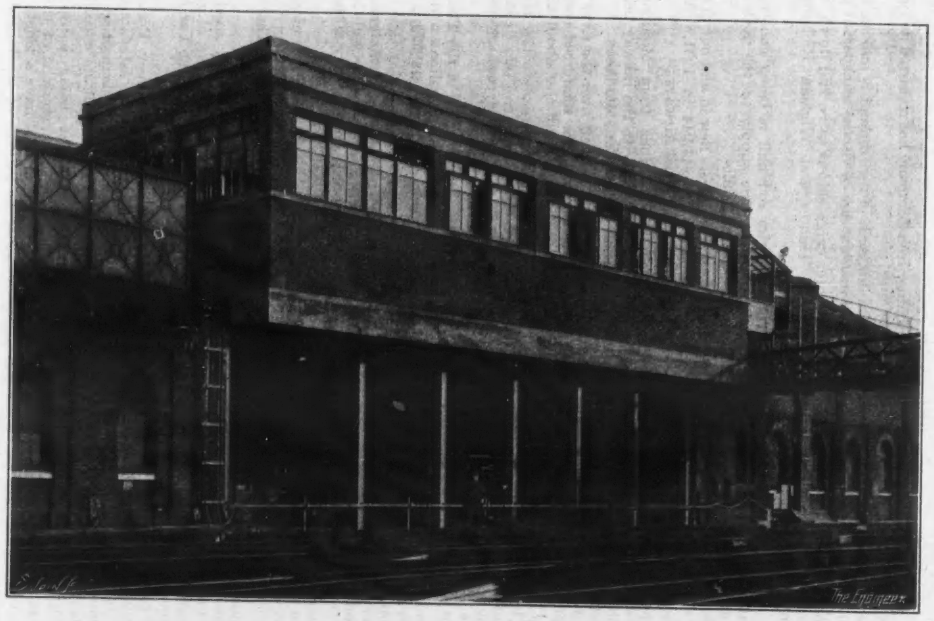
THE Central Electricity Board has started trading operations in the Central Scotland Area, the programme of standardisation of frequencies and the construction of the grid having been completed. The start of trading operations implies that the Board now takes over the responsibility for the cost of producing electricity in the selected stations in Central Scotland, and that authorised undertakers will take energy from these stations at the cost of production, or at the Board's tariff for Central Scotland, whichever is the lower.

THE first section of the tunnel in the Galloway Hills, which will be used to convey part of the Black Water of Dee to the Glenlee power station, was completed on December 27th, about five weeks ahead of schedule, says the *Electrical Review*. This tunnel, which will eventually be 20,000ft. long, will be one of the most important links in the Galloway hydro-electric scheme which is costing about £5,000,000. The section completed last week is about a mile long and extends from the first adit (or temporary entrance) to the portal, where the waters will emerge from the hills and fall through a pipe into the Ken Valley. Here the turbines of the 24,000 kW power station at Glenlee will be operated, the water then being passed on for use at two other power stations.

SOUTHERN RAILWAY—RE-SIGNALLING OF BRIGHTON STATION

(*For description see page* 34.)





The old mechanically-operated South Box and the new electrically-operated box, on the wall of the Locomotive Shops, which has taken its place.

Interior of the old South Box with its 240 heavy hand levers contrasted with the new box with its 225 small levers. Note the illuminated diagram of the lay-out at Brighton Yard above the new frame. Each "block-section" in the diagram is fitted with an electric bulb, which shows whether the section is free or occupied.

The Engineer

JANUARY 13, 1933.

VOL. CLV. No. 4018

Contents.

THE ENGINEER, January 13th, 1933.

	PAGE
A SEVEN-DAY JOURNAL	33
THE RE-SIGNALLING OF BRIGHTON STATION. (Illus.)	34
HARBOURS AND WATERWAYS IN 1932. No. II.	35
THE PHYSICAL SOCIETY'S EXHIBITION. No. I. (Illus.)	37
RAILWAYS IN 1932	39
SHIPBUILDING AND MARINE ENGINEERING IN 1932. No. II. (Illus.)	40
SOUTH AFRICAN ENGINEERING NOTES	42
THE IDLE THOUGHTS OF A BUSY FELLOW	42
CAST IRON REPAIRS IN CHINA	42
RAILWAY AND ROAD MATTERS	43
NOTES AND MEMORANDA	43
MISCELLANEA	43
LEADING ARTICLES—	
Fires in Liners	45
The Dictatorship of Science	45
THE LOSS OF THE "ATLANTIQUE"	46
LITERATURE	46
LETTERS TO THE EDITOR—	
Electric Locomotive Classification	47
Unemployment of Professional Engineers	47
Municipalities and Foreign Contracts	47
Railway Bridges and Road Traffic	47
SIXTY YEARS AGO	47
HUNGARIAN RAILWAYS ELECTRIFICATION. No. II. (Illus.)	48
25-TON OVERHEAD TRAVELLING CRANE. (Illus.)	50
LAWN MOWER GRINDER. (Illus.)	50
MOTOR VESSEL FOR CANALS SERVICE. (Illus.)	50
THE "STANDAGE" RESILIENT COUPLING. (Illus.)	51
MOTOR-DRIVEN RADIAL DRILLING MACHINE. (Illus.)	51
TWO INTERESTING SHAPERS. (Illus.)	52
PROVINCIAL LETTERS—	
The Midlands and Staffordshire	53
Lancashire	53
Sheffield	54
North of England	54
Scotland	55
Wales and Adjoining Counties	55
PERSONAL AND BUSINESS ANNOUNCEMENTS	55
CONTRACTS	55
CALENDARS	55
CURRENT PRICES FOR METALS AND FUELS	56
FRENCH ENGINEERING NOTES	57
BRITISH PATENT SPECIFICATIONS. (Illus.)	57
FORTHCOMING ENGAGEMENTS	58

NOTICES TO READERS.

*** *If any Subscriber abroad should receive* THE ENGINEER *in an imperfect or mutilated condition, he will oblige by giving prompt information of the fact to the Publisher, with the name of the Agent through whom the paper is obtained. Such inconvenience, if suffered, can be remedied by obtaining the paper direct from this office.*

*** *For Subscription rates, see page 2 of Advertisements.*

*** *All letters intended for insertion in* THE ENGINEER *or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

*** *No undertaking can be given to return drawings or manuscripts; correspondents are therefore requested to keep copies.*

FIRES IN LINERS.

THE severe loss which the French mercantile marine has sustained by the destruction of its South American liner "L'Atlantique" has very properly called forth the deep sympathy of all maritime countries. Although with an empty ship the loss of life was much smaller than it otherwise might have been, it was still serious. The highest praise cannot fail to be given to the brave officers and men who from the bridge and in the engine-room unsuccessfully fought the fire, until they were obliged temporarily to evacuate the ship, but reboarded her again when, after two days' drifting in the English Channel, she was, in charge of salvage tugs, brought safely into Cherbourg Harbour on Saturday evening last, where she awaits dry-docking and examination. It is worthy of record that despite her fire-stricken hull and superstructure, her machinery was, it appears, not seriously damaged, and that steam was raised in one of the boilers, so that her own pumps assisted in putting out such fire as remained. Coming so soon after the total loss by fire of the liner "Georges Philippar," the "L'Atlantique" disaster raises once again in an acute form many questions affecting the design of the modern large liner from a fire-fighting point of view, and the means which it is necessary to adopt if serious fires are to be avoided, either at sea or in port. We mention port fires, having in mind the various fires which have taken place on ships under construction or repair, and that which occurred at Le Havre in the "France" on Sunday last, happily without doing much damage. The prevention of fires aboard ship is a matter of international interest, which concerns shipowners and shipbuilders, insurance interests, and, above all, the travelling public of all countries, which when disasters of this kind are near at hand need to be reassured as to the great safety of sea travel. We understand that, in addition to the preliminary technical inquiry now being conducted by the Minister of Mercantile Marine at Cherbourg, a further inquiry, probably in Paris, will deal with judicial aspects, and will seek not only to establish the cause of the fire and account for the amazing manner in which it spread through the ship, but also to draw up recommendations which may prevent the recurrence of similar disasters. The findings of these inquiries will be of the greatest interest to naval architects and marine engineers, as they cannot fail to influence in no small degree the designs for the completion of the world's two largest liners, one recently launched at St. Nazaire and the other still on the stocks at Clydebank, as well as to contribute to the safe maintenance of the many fine ships recently put into service in Europe and in America.

The circumstances of the fire on the liner "L'Atlantique" are recounted elsewhere in this issue. We only need record here that in spite of the careful designs of the French naval architects and engineers, who equipped the ship with what was held to be a complete fire-detecting and extinguishing system, the fire, which started, it is understood, in a first-class cabin immediately below the wireless room, spread with a rapidity which surprised the captain and officers, and is difficult to understand. So quick were the destroying flames that the wireless operator had only time to send off one S O S message before his instruments were destroyed. Since a similar happening took place on the "Georges Philippar," the installation of duplicated wireless control stations, similar to those commonly adopted in naval practice, is certain to receive consideration. In view of the well-designed fire-fighting equipment on "L'Atlantique," which included high-pressure salt water, steam, CO_2 gas, and foam services, it can only be assumed that the materials of which the cabin and public rooms were constructed, and the manner in which they were disposed, made it impossible to hold the flames in check with the means available. Few people realise the amount of inflammable material which goes to the construction, fitting out, and furnishing of a huge modern luxury liner. The wood employed, much of it in panel form, may amount to more than 1000 tons, and in the furnishing of the cabins and other passenger accommodation, up to 200 tons of paint, enamel, and varnish may be needed. Since it has been reported that some of the electrical cables acted as fire conductors on the "L'Atlantique," we may mention that in all probability over 400 miles of cables and wires were used for her high and low-pressure electric services. If there be added to these materials the tapestries, textiles, and rubber flooring material, essential for furnishing and decorating, there is created—by the air conditions in the 'tween deck spaces, which include lift shafts, stairways, lofty rooms, and corridors— a fire risk which would unhesitatingly be condemned by the London Fire Brigade or other similar authorities. Unless such conditions can be avoided more direct methods of protection will have to be adopted, and it is now generally recognised that sprinkler systems, which have been so successful in preventing fires in cotton mills, chemical factories, wood-working yards, and other serious fire risks on land, might be employed with similar advantage at sea. To the best of our knowledge, the sprinkler system has been fitted on only two passenger ships—the "Leviathan" and "Berengaria"—and then only to a limited extent, but there appears to be no inherent objection to it; and in view of the lower insurance rates that might follow its use, the additional expenditure—probably amounting, in round figures, to about one per cent. of the total cost of the ship—might well be justified. For a description of the problem of fires on ships in all its aspects, we recommend Mr. Leslie Champness's paper on "Fires on Ships," recently read before the North-East Coast Institution of Engineers and Shipbuilders, at Newcastle, and the valuable discussion which followed it. It sums up in an admirable way the problems presented and suggests methods for their solution.

The prevention of fires aboard ship has for more than six months past occupied the attention of a strong British Committee, meeting under the auspices of the Shipbuilding Employers' Federation and the Chamber of Shipping, which will duly report to the Board of Trade. On this Committee are represented shipowners, underwriters, the classification societies, and shipbuilders. At the present time a Shipbuilders' Sub-committee is considering such important matters as subdivision and the various systems of fire detection and protection, including the materials used and the possible employment of fire-resisting wood and fire-resisting paints and varnishes. Private firms have co-operated with the members of this Committee to place before it experimental evidence as to the use of sprinkler systems for putting out cabin and engine-room fires, the behaviour of cabin ventilating systems under fire conditions, and the possible uses of CO_2 gas in conjunction with such systems, also the use of automatic light control apparatus for fire detection and extinguishing. The most up-to-date practice of our leading shipping companies with regard to fireproof cables, the fuse protection of wiring circuits, the avoidance of hot gas-filled lamps in confined spaces, and other like matters is being carefully considered by the Committee, with a view to placing a report before the shipowners and the later incorporation of appropriate rules in the Merchant Shipping Act. It seems very desirable that there should be close co-operation between British and French naval architects and marine engineers, with a view to sharing the knowledge gained from the investigation of recent fires on French liners. This is necessary in the interests of progress and safety in future liner design, and might be effected either through Government Departments or the Chamber of Shipping and the International Chamber of Commerce in Paris, or by collaboration between the Institution of Naval Architects and the Association Technique Maritime et Aéronautique.

Whilst it is notoriously unsafe to boast, we feel impelled to say, and to say with confidence, that British sea travel is the safest in the world. The last serious fire on a British liner took place on the "Volturno" in 1913, and the Board of Trade returns show that in the last ten years only nine passengers lost their lives in fires on British ships at sea or in port. An interesting point in connection with serious fires aboard ship is the comparative immunity from fires when a large number of passengers and crew are about the ship, or when building or under repair, a large number of workmen are present. Most of the fires occur at night or in the early morning hours. A professional fire brigade chosen from the ship's staff, which, it is reported, has been provided in the case of the large Italian liner "Rex," may be advisable for the very large liners. But, when everything has been done from the technical point of view, the personal question remains, and each passenger must be prepared to contribute to the safety of the ship by his or her conduct and to take part loyally in fire drill or any other means which may be deemed necessary to uphold the high tradition of the British Mercantile Marine in all matters relating to the safe navigation of ships.

The Dictatorship of Science.

WITHIN recent years many thoughtful students and observers of our political organisation have, in one form of words or another, expressed the opinion that the time has come for a wide infusion of the scientific spirit into that organisation, and for the adoption, on a generous and wholehearted scale, of scientific methods for resolving all questions affecting the nation's well-being and good government. Too long, they argue, have we been at the mercy of party prejudice and political dogma. Strong lungs, long purses, and the interplay of personality have been the chief factors determining our destiny. The growth in the influence of science on our everyday lives demands, it is urged, that these time-worn forces should no longer be allowed to shape the affairs of State, that they should be abolished, and that they should be replaced by the calm, unbiassed scrutiny of a senate imbued with the scientific spirit. The views commonly expressed on this subject are as yet largely uncrystallised. Few of the advocates of reform go so far as to recommend that our national legislative body should be, out and out, a parliament of scientists; that is to say, of men who before being called to the service of the nation had devoted their lives to the study of science in one or other of its many branches and had obtained eminence therein. For the most part, the reformers would be content if our legislators and rulers would openly and loyally agree to accept Science as their leader and would cultivate and adopt the scientific habit of mind in their treatment and discussion of all questions laid before them for their decision. Even on this limited basis it is not wholly self-evident that the reform is practicable and desirable. But, granted that it be both, it is very certain that the changes wrought by its introduction would be momentous and revolutionary to a degree to which the nation as a whole would probably hesitate to proceed.

The scientific outlook cannot be acquired in a day, like a pair of new spectacles. Only in rare cases can it be acquired at all, even with the most diligent study, by anyone who has reached middle life without it. It represents a certain orderliness of thought and argument, and openness of mind before coming to a conclusion, which have their

roots in early training, and which, if not sown in our youth, will not attain vigour in later life. To educate our present race of parliamentarians to take a scientific attitude towards their duties would be a hopeless task. The attainment of the reformers' desires would necessitate the recruitment of Parliament from a body of people trained to the scientific outlook from their schooldays, trained, that is to say, to science as a cultural study rather than as an aid to technical ends. Herein it becomes clear that the reform is dependent upon a great antecedent reform—in many ways doubtlessly a very desirable reform—in the attitude of Education towards science. The change in our political organisation would be of a further momentous and revolutionary character in that, sooner or later, it would inevitably end the parliamentary party system as we now know it. Just as science is international, so does it recognise no party. Newton's laws of motion are as binding upon the Labour Member as upon the Conservative, and so, too, will be the laws of economics and sociology, once they have been as firmly and as certainly established. The reform would leave no necessity and no opportunity for an Opposition. Guided by the undisputable dictates of science, all decisions, in the ultimate ideal stage of the reform, would be reached unanimously, unless some Einstein of the back benches arose to challenge and upset accepted scientific doctrine. Again, science at the hustings would be a sorry sight. We could not, with dignity, allow candidates to set their scientific qualifications in competition, nor would it be reasonable or safe to leave the electors to exercise their judgment in the capacity of examiners in science which would be thrust upon them. Some fresh method of selecting our legislators would be required, some method in which the votes of the populace would play no part, some method perhaps based on appointment by dictatorial authority. These and other great changes in our political organisation which the reform would involve might not be immediately and spontaneously accepted by the nation as a whole, although it is conceivable that a minority might regard them with equanimity, and possibly even as blessings. They certainly do not constitute by themselves any insuperable objection to the suggested reform or any reason for condemning it out of hand. A different aspect, however, is revealed when we come to consider the practicability and desirability of the reform. Behind the suggestion there lies a belief in the scientist as a species of superman, or, at any rate, an exaggerated faith in his ability to think and decide correctly on all questions, whatever their nature, that might be laid before him. Long contact with scientific circles has taught us that outside his own department the scientist is, in general, a trifle impractical, a little unworldly, distinguished by his modesty and by his readiness to confess ignorance on subjects which being beyond his domain he has never studied and does not understand. His instinct is to shun hasty judgment and to express no opinion on any subject until, by experimental or other means of investigation, he has gathered together, sorted out and analysed all its details. Science does not deal with opinions, but with established facts. The very essence of politics is its opinions, and we are fully persuaded that in its atmosphere the scientist would either become dumb or would cease to be scientific.

At the present moment science has little real cause to complain of being neglected in the conduct of the nation's business. There never has been a time when scientists were consulted more frequently than to-day by politicians when framing their programmes and legislation, and, it may be added, when their advice and guidance were more readily accepted and made effective. No Act is passed, no policy is set up, if it embodies technical considerations, without the help of a committee or commission composed of scientists or before which scientists are given every opportunity to make their voices heard. To elevate the scientist from the committee-room to Parliament itself, to place in his hands power to enforce what he is now permitted to recommend, would be to the advantage neither of the nation nor the scientist, and might be dangerous. It is entirely against our constitutional practice to have a professional sailor as the First Lord of the Admiralty or to have other than a civilian Secretary of State for War. There are sound reasons for that practice, and, let our lives become still more and more prescribed and circumscribed by the advancement of science, there will always be equally sound reasons against placing scientists in legislative control over the nation. We cannot shut our eyes to the fact that the non-scientific public distrusts and fears scientific progress. It counts the benefits which it has received from it, but it sees, or believes it sees, in it the cause of many modern evils in our social organisation. Science itself has still not the shadow of an opinion to offer as to whether its ultimate development will be for the good or the hurt of mankind, whether it will heal our woes or destroy us. Until that point has been resolved beyond all doubt it will be wise, both scientifically and politically, to keep science as a servant, and to avoid any voluntary action encouraging its dictatorship.

The Loss of the "Atlantique."

(From our Correspondent in Paris).

THE loss by fire of the "Atlantique," which occurred in the Channel last week, has given rise to more technical discussion than any marine disaster for many years past. It is unfortunate that when such an accident is complete, there can be no certainty as to how it originated, and nothing remains but hypotheses based, for the most part, on very slight evidence. The absence of any definite knowledge as to the origin of the fire which destroyed the French liner is all the more bewildering because the circumstances are almost identical with those under which the "Georges Philippar" was burnt off Cape Guardafui, on the Somali coast, a little more than eight months ago. It is, also, the climax to a series of disasters during the past six years, in which six French liners have been either partially or wholly destroyed by fire. Three of them were badly damaged by fire in French harbours, and in 1930 the "Asia" succumbed to the flames in the Red Sea with heavy loss of life. Frenchmen regard this series of disasters as something more than a normal fatality. In the case of the "Georges Philippar" and the "Atlantique," the vessels represented the last word in the art of shipbuilding. Like the "Normandie," which is intended to be the palatial home of passengers across the North Atlantic, the "Georges Philippar," of the Messageries Maritimes, was constructed with the idea of offering the most attractive conditions of travel to and from the Far East, while the 42,000-ton "Atlantique," running between the Gironde and Buenos Aires, was the most magnificent vessel in the South Atlantic service. With her hull divided by nineteen watertight bulkheads she was believed to be unsinkable, and, like the "Georges Philippar," she was equipped with the most perfect fire alarm and extinguishing systems that modern shipbuilding practice could devise. The fire-fighting equipment in the "Atlantique" included, besides fireproof bulkheads, thirteen fire-resisting curtains of steel and asbestos in the upper 'tween deck spaces. The salt water fire main was supplied by two fire pumps, and the sanitary pumps could also be used. There were over two hundred hydrants, giving two hoses at all strategic points in the ship. The holds and 'tween deck spaces were protected by steam extinguishers, while an extensive fixed and portable CO_2 gas and foam system was available in the passenger accommodation, and in the engine and boiler-rooms. There were over fifty fire alarm stations with main indicators on the bridge and in the engine-room. This extensive equipment seemed to eliminate all risk of danger. Nevertheless, both ships were destroyed in apparently the same manner.

The origin of the fire in the "Georges Philippar" was regarded as mysterious, because, according to the evidence of passengers, it broke out almost simultaneously in a number of cabins. The results of the official inquiry into the disaster have not been published, nor will they be made public, and this absence of official explanation aroused in the public the belief that human agency must have been at work to destroy the ship. Such a theory is, naturally, rejected alike by the shipping companies and by engineers, but the feeling cannot be ignored when the public believes that its fears are confirmed by the similar loss of the "Atlantique." This ship was proceeding with 229 officers and men from the Gironde to Le Havre to be dry-docked, when, according to the captain, the fire broke out in a first-class cabin and the flames spread with astonishing rapidity. This is exactly what happened in the "Georges Philippar." The idea that the fire started at different points almost simultaneously in the latter ship has always been accepted on the testimony of passengers. After what occurred last week it may be assumed that frightened passengers could not explain otherwise the rapid spreading of the fire. If, in the space of a few minutes, the fire could get beyond the control of an elaborate extinguishing system, it can only be supposed that the material in contact with the fire was of a highly inflammable character. The inquiry being carried out by the Technical Commission of the marine, and the separate investigation being undertaken by the Government, will obviously have little to go upon in determining the exact cause of the disaster. The necessity of suppressing inflammable material as much as possible was impressed upon Monsieur Georges Philippar, president of the Messageries Maritimes, after the loss of the ship bearing his name, and in the "President Doumer," which was recently launched, wood will only employed where it cannot be replaced by metal, and three-ply wood will be used wherever possible, while the chart house is entirely metallic. The wells of lifts will be provided with means of closing them hermetically to prevent up-draughts in case of fire. Cabins will be built on land to test various alleged non-combustible materials, and so far as the spreading of fire is concerned, it is hoped to reduce risk to a minimum.

The new liners built at the instigation of the French Government, and subventioned by it, were intended to draw traffic by the luxuriousness of their arrangements. There would be nothing like them on the seas. The "Atlantique" was a sumptuous floating hotel, in which it was sought to give passengers as little as possible the impression of being afloat. The artists were allowed a free hand, and it does not appear that they were influenced by any consideration of the inflammable character of the materials they employed. Paintings, wood, varnish, fibrous mouldings, were used to make the interior of the ship as attractive as could be desired by South American travellers. This constituted a ready fuel to feed an incipient fire. The captain of the "Atlantique" declared that the fire was propagated at an alarming speed through the burning of varnish. The idea of attracting custom by artistic surroundings may be psychologically sound, but there is plenty of reason for believing that French naval architects now see that their own work must not be imperilled by the efforts of others, who have no knowledge of the sea, to make the interior of a ship a luxurious work of art.

Literature.

L'Egypte et ses Chemins de Fer. Par LIONEL WIENER. Ouvrage publié sous les auspices de Sa Majesté Fouad 1er, à l'occasion de la XIIe. session du Congrès International des Chemins de Fer (le Caire, 1933). Bruxelles, 1932. M. Weissenbruch S.A.

WE have here a magnificent book, of 665 large pages and fully illustrated, which has been specially prepared in view of the Railway Congress which is to be held in Cairo this month, and has been sent to us by the Commission Locale d'Organisation, Cairo.

The railways of Egypt are of exceptional interest from a locomotive point of view: first, because in their earlier period they had samples of the finest machines from many different countries; secondly, and to a lesser degree, on account of the remarkable series of experiments carried out by F. H. Trevithick in the direction of feed-water heating.

Mr. Wiener presents a most thorough picture of the whole of the railways of the country—State, company, agricultural, mining, and military. The first line, which was planned by Robert Stephenson, ran from Alexandria to Suez *vid* Cairo, and was opened in 1858. Previously there had been much sparring between the French, who wanted the canal, and the English, who backed the railway, and did not believe in the canal, which was completed in 1869, and caused an almost total eclipse of the prosperity that the railway had previously enjoyed. The line from Cairo to Suez across the desert was abandoned later in favour of a less direct, but more inhabited, route; but has been recently reconstructed. Between 1863 and 1869 over 500 miles of line were laid. Development then slowed down. The constable had been outrun, and from 1879 to 1888 nothing was done. In 1904 a total reorganisation took place. The war had its own special effects, some military lines being laid down with material borrowed from existing ones, which has mostly been returned. An interesting peculiarity of the climate is that in many places the sleepers last longer than the rails.

A very full account is given of the locomotives, which, as has been remarked, are very interesting. Many are illustrated, including two very gaudy examples in colour. In the old spacious days, Said Pacha, who did not mind what money he spent, ordered any engine that took his fancy, quite irrespective of its suitability; even going in for three of the Caledonian 8ft. 2in. singles. The day of reckoning came, and from 1870 to 1888, not only were no new engines bought, but hardly any were repaired. The only thing that was done to keep the old crocks going was the easy and cheap method of lowering the pressure.

Trevithick, who took charge in 1883, gradually introduced reforms, but had to go slowly at first—he was allowed to buy one new boiler in 1884 and two more in 1885—and brought out some very handsome designs.

There was an excellent opportunity here for comparing engines of different nationalities, and it was not altogether neglected. It was found that Belgian engines used less fuel and oil than the British, but cost much more for repairs, owing to poorer materials. American goods engines burnt 25·4 per cent. and passenger 14·2 per cent. more coal than the English. De Glehn compounds gave excellent service, but were dropped owing to their being more complicated than a simple engine with superheater. Other compounds tried were a Vauclain and a three-cylinder.

Owing to the high cost of coal, Trevithick carried out his classic series of experiments with feed-water

heaters and superheaters, which he began in 1900, and continued until his retirement in 1913. Mr. Wiener gives details of all his various attempts, which produced economies of 10 to 20 per cent.; but when one considers first cost, upkeep, and the inconvenience attached to the various devices, it does not appear that the game was worth the candle. We read of one "drum" having 798 tubes and another 818.

There are full details of all the other kinds of rolling stock, and statistics of every sort. The second part deals with the many small railways in the country, some narrow gauge, some standard.

Misprints are few and far between; English names are, of course, always a stumbling block to foreign printers. It is unfortunate that the second portrait of Robert Stephenson should have been entitled "George," but the text shows that the author knows better. The illustrations are splendid, those of the nature of a landscape especially so, and the book is altogether a monument of industry.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents).

ELECTRIC LOCOMOTIVE CLASSIFICATION.

SIR,—While the principles applied to the nomenclature of electric locomotives are generally understood, there are one or two points in the present system which require slight modification if a clear idea of the locomotive driving system and the chassis lay-out are to be obtained. That this is of some importance is shown by the attention now being given to the subject by the British Standards Institution. For a B.S.I. specification to be of any value it must be complete, but it is in just this particular that trouble is likely to occur, for the number of combinations is legion.

The use of + and − signs to indicate the provision or omission of articulation between two trucks is well known, but I would suggest that the former be used only when buffing *and* drag stresses are taken through the bogies, and for these reasons. As first built, the G.I.P. goods locomotives were articulated by a system which professed to look after the guiding action only; rightly, these machines have always been classed C−C. But there is in existence a class of double-bogie locomotive, which has been built in goodly numbers, in which the drag stresses are transmitted through the body (the buffer and draw gear being mounted on the bogies), although the buffing stresses are taken up directly between the bogies and kept away from the cab.

This type is rightly classed as 1B−B1, for the carrying wheels are rigid in the main bogie frame; if these wheels had been arranged in pony trucks it would have been necessary to write 1−B−B−1, a point which does not seem to be thoroughly understood. But the latest, series of these locomotives, instead of having two bogies are provided with a rigid frame structure, although the two driving systems are kept separate as before. The carrying wheels are still in the main frame structure, but have a comparatively large amount of spring-controlled side play. While the locomotive is a single unit, it would not be correct to class it as 1−D−1; the owning railway company write 1B−B1, but the true symbol is 1BB1, that is, without the use of any hyphens whatever.

A further point arises in the description of a five-axle locomotive with all wheels coupled, but with only three axles driven by nose-suspended motors. Such a class is now working successfully, and the number will probably be increased. While type E has so far been applied something more is required, for as the system is at present constituted a type E locomotive can have two to four nose-suspended motors arranged in different positions, as described above, or may have two large motors with a Scotch yoke drive, as in the Italian locomotives.

For locomotives which are invariably worked in double or triple formation, such as the freight power of the Norfolk and Western and Virginian Railroads, it has been the practice to write out fully 1−B+B−1+1−B+B−1, and so on. A much simpler method would be to say 2 (1−B+B−1) or 3 (1−B+B−1), as the case may be.

While the B.S.I. is understood to be endeavouring to standardise the use of the larger number of carrying axles as No. 1 end—that is, 2−C−1 instead of 1−C−2—this is not invariably the practice on the Continent, and unless the B.S.I. can come to an agreement with American and Continental institutions much of the value of its specification will be lost.

BRIAN REED.

London, S.E.3, December 29th.

UNEMPLOYMENT OF PROFESSIONAL ENGINEERS.

SIR,—I should like to express my appreciation of your recent Editorials, "Unemployment of Professional Engineers" and "Culture and Technology." Between them they draw attention to many points which are of great interest to anyone who has the welfare of the profession at heart.

For the moment, I wish to enlarge upon one aspect of the problems you discussed. I have felt for some time that the large increase in the productive capacity of our centres of higher technical education is no more an unmixed blessing than was, shall we say, the large increase in the productive capacity of the iron and steel industry which followed upon the war. I submit that the policy of our educational institutions is open to strong criticism. They have justified their growth on the ground that more education is in itself good. Now, more knowledge is, I agree, in itself good, but almost all young people view their higher education in science and technology as essentially vocational. It cannot be too strongly stressed that, when this has been their attitude, the realisation of how little their education of itself avails them in their struggle to find employment, leads to a bitter discontent. Such disillusionment breeds a state of mind which is very dangerous to the community.

One realises the difficulty in a profession which is not closed of exercising any control upon the numbers entering the profession. Would it not, however, be possible for our senior professional institutions to tackle this matter jointly and quickly, to make an estimate of how many the profession can normally absorb, and to use their influence with the universities and colleges to discourage aspirants in excess of that number? It is obvious that it could only be done very roughly, and that any check would be merely in the form of discouragement, and not prohibition, but I suggest that it would be of some use.

Personally, I should like to see a scheme, which was followed by the late Professor of Engineering at one of the Northern universities, generally adopted. He would accept no student who had not served for at least one year in an engineering works. This policy had many points in its favour, two of which are relevant to the matter under discussion:—

(1) That it weeded out at a very early stage those who were really unsuitable as they found that they disliked the practical work.

(2) That it prevented more men receiving theoretical training than had managed to get some works to take them on. This check would be hardly adequate, as more boys can be found work in the shops than can later be given adequate opportunities as staff engineers, but it would work in the right direction.

The sooner one is brought up against the difficulties of obtaining employment, the better. I feel that it is cruel to allow young men to remain in ignorance until they find that their academic success, and perhaps their expensive pupilage, carry very little weight.

January 2nd. S.M.I. MECH. E.

SIR,—You were kind enough to give publicity to my letter on the topic of "Unemployment of Professional Engineers" in your issue of the 23rd ult., and, although there has been no further correspondence on this subject published in your columns since then, I feel sure there must be a number of civil engineers who, like myself, find time hanging heavily on their hands, and would, for this reason alone, if for no other, be only too willing to co-operate with a view to evolving some means whereby we could not only fill in our enforced idle hours, but do so in a manner useful to those younger members of the profession who have not yet had the advantage of much experience on outside works other than perhaps those of minor importance.

Those who may have been kind enough to read my letter, above referred to, will doubtless recall that what I proposed was a scheme whereby instructional centres would be formed, with the object of letting junior members of the civil engineering profession (also other branches, if found feasible), benefit from the experience of the more senior members, many of whom have been on important works, both at home and abroad, and are at present disengaged.

Some such arrangement as this would seem preferable to allowing the kind of "dry-rot" that has in many cases set in to continue indefinitely, to the detriment of the future supply of competent civil engineers, and would be intended to be the equivalent to that which is being done for lads just out of their mechanical engineering courses, as mentioned under A Retrospect in your New Year number. Such courses of lectures as might be given at these suggested instructional centres, would in no way be intended to compete with or take the place of either the ordinary meetings or the student meetings of the engineering institutions, which are held in London and the provinces during winter months. These latter are all very well for those who live within reasonable distance of the places at which they are held, but many of us live much too far away to take advantage of them.

If only, as is also suggested in my previous letter, one or other of these institutions could be got to take an interest in some such scheme as the one I now visualise, the question of the proper organisation and remuneration of those taking part therein might be gone into. With no one to guide our footsteps, however, all I can do is to ask those who would be willing to take part either in some such scheme as the one I put forward or who may have an alternative plan to suggest, to communicate with me, care of THE ENGINEER, whose Editor I am hoping will be kind enough to forward such correspondence as may take place. I have no doubt that you, Sir, would be kind enough to deal with any letters addressed direct to yourself, should you consider that a preferable arrangement.

Eastbourne, January 10th. P. C. RUTHVEN.

MUNICIPALITIES AND FOREIGN CONTRACTS.

SIR,—Too little attention, it seems to me, has been aroused by the decision of the Birmingham City Council that "no article or manufactured materials produced or manufactured in any place other than the British Isles, India, or British Dominions beyond the seas should be supplied by a contractor without the authority of the Committee concerned."

The importance of the step taken by Birmingham lies, not so much in its immediate application, as in its relation to a stricter trend of public policy to be noted to-day in many European countries, where it is now very difficult, and in some cases impossible, for a manufacturing subsidiary of a foreign company to obtain Government and municipal contracts.

The question, in brief, which now arises is not whether Birmingham is going too far, but rather whether she has gone far enough. Should our municipalities refuse contracts to companies which are not nationally controlled?

In Germany, as in Italy, definite difficulties are placed in the way of trading by non-German and non-Italian concerns respectively, and similar restrictions apply in many other countries. In Spain, for instance, special advantages are given to manufacturing concerns of which two-thirds of the board, with its chairman as managing director, are Spanish nationals and 75 per cent. of the capital is owned by Spaniards. The attitude of the Irish Free State is similar in tendency.

GEO. G. MITCHESON.

London, S.W., January 6th.

RAILWAY BRIDGES AND ROAD TRAFFIC.

SIR,—I have read with interest on page 667 of THE ENGINEER for December 30th the reference to the suggestion put forward by Mr. E. L. Leeming to deck in certain railway bridges for road vehicles as an auxiliary source of revenue. I am not a railway engineer, but it seems to me that it should be possible to operate a shuttle train service carrying road vehicles across, say, the Forth Bridge. Such a service could be carried out with oil engine-driven rolling stock. As this would not involve any stand-by losses it would be possible to offer very rapid transport across the Forth at any hour of the day or night in contrast with the present ferry, which necessarily makes only a few trips each day. B.SC.

London, December 30th.

SIXTY YEARS AGO.

BESSEMER'S suggestion for the construction of a cross-Channel steamer fitted with a swinging cabin, the movement of which relatively to the ship's hull was to be controlled by means of manually operated hydraulic rams, attracted wide attention when it was first advanced in 1872. As we recorded in this note a few weeks ago, Bessemer followed up his original suggestion by proposing to replace the manual operation of the rams by automatic operation with a gyroscope as the controlling device. It is possible that he obtained the idea of employing a gyroscope from a letter which we published in our issue of January 10th, 1873. The writer was Mr. A. Alexander, of the Cyclops Steel and Ironworks, Sheffield. Precisely how he intended his gyroscopic device to control the valves of the hydraulic system is not quite clear, but it was based on "the tendency of the gyroscopic disc to maintain an invariable parallelism of plane." He was concerned, too, lest the disc should "owing to the inertia of its rim," develop a precessional movement which would "be fatal to the steadiness of the platform controlled by it." He, therefore, proposed to overcome this precessional movement by employing two gyroscopic discs mounted on the same axle, one above and one below the horizontal axis of suspension. It may be noted that the same misunderstanding of the theory of the gyroscope marked Bessemer's subsequent proposal, and that when the true method of employing the gyroscope for the required purpose was expounded by Macfarlane Grey, Bessemer refused to have anything farther to do with the idea. Our correspondent, Mr. Alexander, proposed to drive the gyroscope by admitting steam through the trunnion bearings and passing it through the axle to escape tangentially through orifices on the periphery of the discs "like the ancient æolipile," as he put it, or like a reaction turbine, as we would now describe it. . . . In the same issue a paragraph appeared which made it clear that Bessemer was to have a rival in his efforts to circumvent the cause of sea-sickness. A message from St. Petersburg stated that Monsieur Alexandrovski, previously known as the inventor of an "under-water vessel," had devised a scheme for stabilising a ship's cabin by floating it "in a kind of tank placed amidships between the engines." The invention had been recently tested by the Grand Duke Constantine in his capacity as head of the Naval Department, and had given perfectly satisfactory results, "all efforts to shake the cabin proving utterly unsuccessful." The invention, it was stated, stabilised the cabin against both rolling and pitching. The inventor was about to leave for England and France to patent the scheme in those countries. It would seem that Monsieur Alexandrovski was working on a system not greatly different in principle from that of the Frahm anti-rolling tank system. He presumably designed his floating cabin to have a period of oscillation in the athwartship direction equal to the rolling period of the ship, and a period of oscillation in the fore and aft direction equal to the pitching period of the ship. . . . To the couplet of names—Alexander and Alexandrovski—mentioned in this paragraph, we may perhaps add a third, that of Dr. Alexanderson, of Schenectady, who is at present studying the stabilisation of ships by means of automatically controlled fins projecting from the sides.

Hungarian Railways Electrification.

No. II. (*conclusion*).*

CONTINUING the description of the Kando system from our issue of last week we note that the main contractors, Ganz and Co., Ltd., of Budapest, undertook the work of making the phase converters, master controllers, indicating instruments, one of the two motor-driven air compressors, and various other items of the equipment for the thirty-six passenger and goods locomotives, whilst the Metropolitan-Vickers Electrical Company is supplying the 2500 horse-power motors, the liquid starters, pole-changing switch groups, oil circuit breakers, motor-operated ventilating fans, the additional motor-driven air compressors, phase converter exciters, pantographs, &c. The mechanical parts of the locomotives are being constructed by the Royal Hungarian State Engineering Works, of Budapest. As shown in the following table, apart from the wheel arrangement and wheel diameters, the passenger and goods locomotives are very similar, the electrical equipment being identical. The principal particulars of the passenger and goods locomotives are as follows :—

Type.	Passenger.	Goods.
Wheel arrangement	2–8–2	0–12–0
Service weight of locomotive	93 tons	93 tons
Overall length	44ft. 11in.	44ft. 1in.
Fixed wheel base	20ft. 10¼in.	25ft. 9in.
Diameter of driving wheels (new)	5ft. 5½in.	3ft. 9½in.
Diameter of trailing wheels (new)	3ft. 5in.	—
Adhesive weight	65½ tons	93 tons
Continuous rating of motor on third and fourth speeds	2200 H.P.	2200 H.P.
Five-minute rating of motor on third and fourth speeds	3500 H.P.	3500 H.P.

It was specified that the passenger locomotives should be capable of accelerating within a period of 360 seconds up to a speed of 51 miles per hour when hauling a train of 590 tons composed of eight-wheeled cars on an up gradient of 1/150 and on a curve of 1312ft. average radius, whilst under the same track conditions the goods locomotives are required to accelerate within 165 seconds up to a speed of 9·75 miles per hour with a trailing load of 1476 tons, composed of four-wheeled goods wagons with a total of 150 axles. Tests have shown that these and other requirements are easily met and the general performance of the locomotives has apparently left nothing to be desired. The economical speeds obtained by pole changing are as follows :—

	Passenger.	Freight.
First	15·1	10·4
Second	31·2	21·3
Third	46·8	32·1
Fourth	62 4	42·6

The maximum specified speed for the passenger locomotives when hauling trains as above over a 1/1000 gradient is 62·4 miles per hour and that for the goods locomotives 32·1 miles per hour, the temperature rise allowed for the electrical machinery being in accordance with the V.D.E. rules (1929) for traction motors.

The general arrangement of a passenger locomotive is shown in Fig. 4, where A is the oil circuit breaker, B the phase converter for converting the single-phase current into multiphase current, and C the exciter for this converter. D is an oil and water cooling equipment for the converter, E the main traction motor with a ventilating fan F, G the liquid starter, H air compressors, J the cooling water

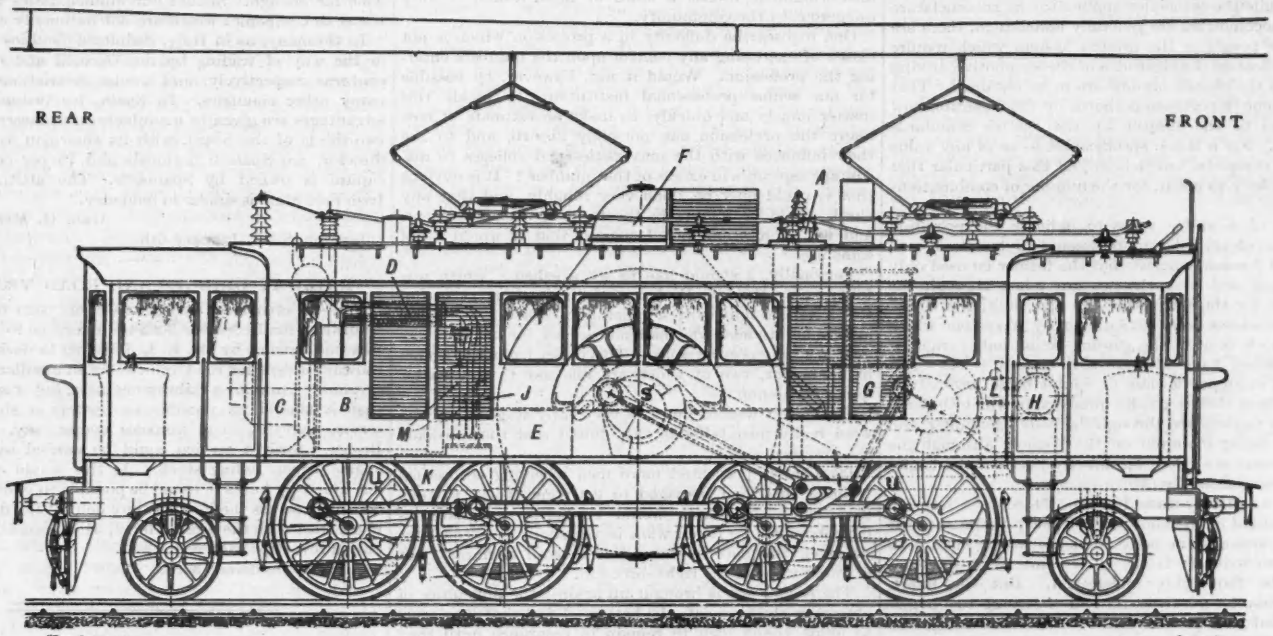


FIG. 4—EXPRESS PASSENGER LOCOMOTIVE

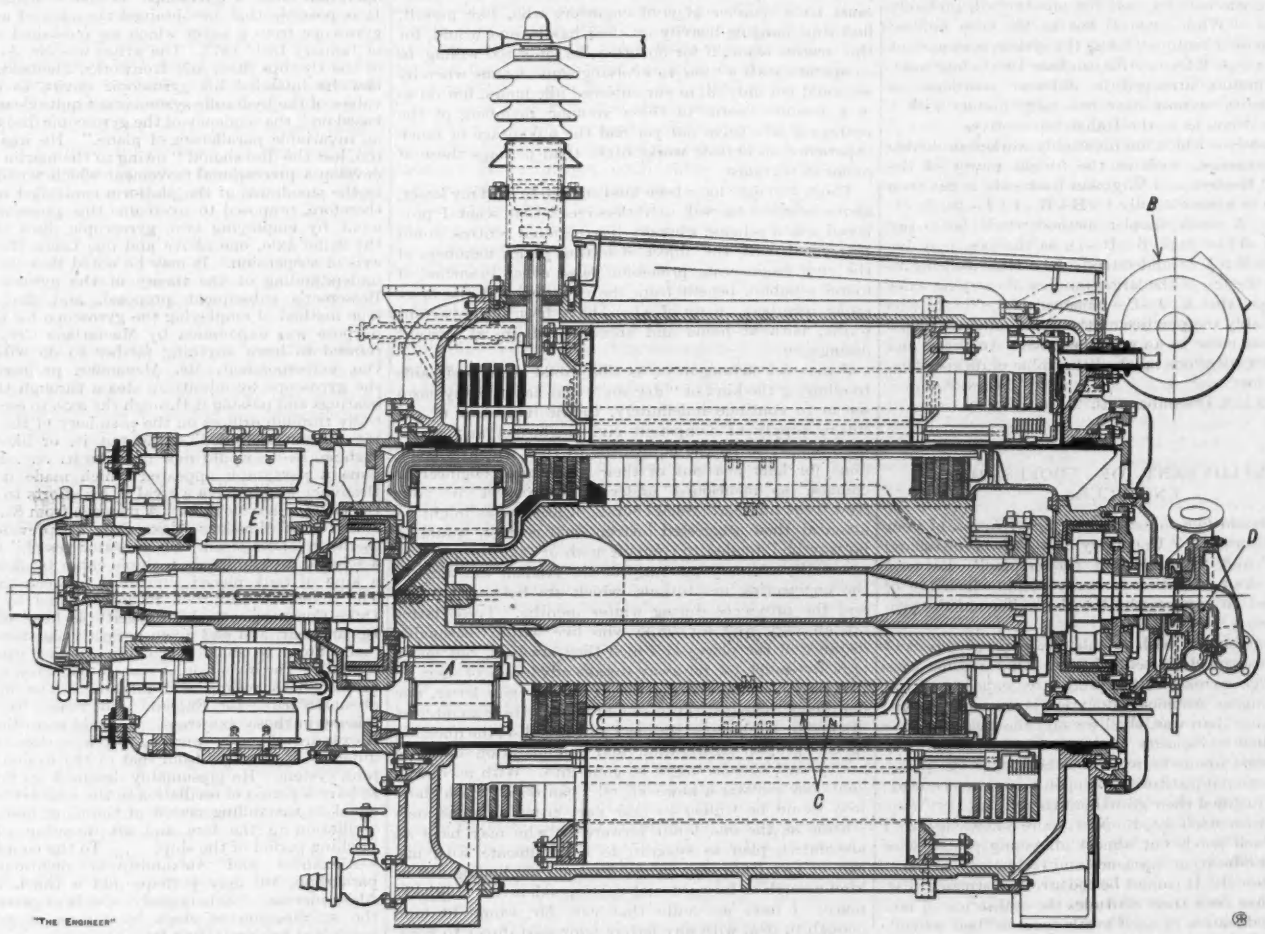


FIG. 5—SECTION THROUGH PHASE CONVERTER

circulating pump, K the cooling water tank, L the pumps for the liquid starter, and M an auxiliary pump for the cooling water. A complete passenger locomotive is shown in Fig. 6. Fifty-cycle current at 1600 volts is collected from the overhead wire by two pantographs and after passing through the main

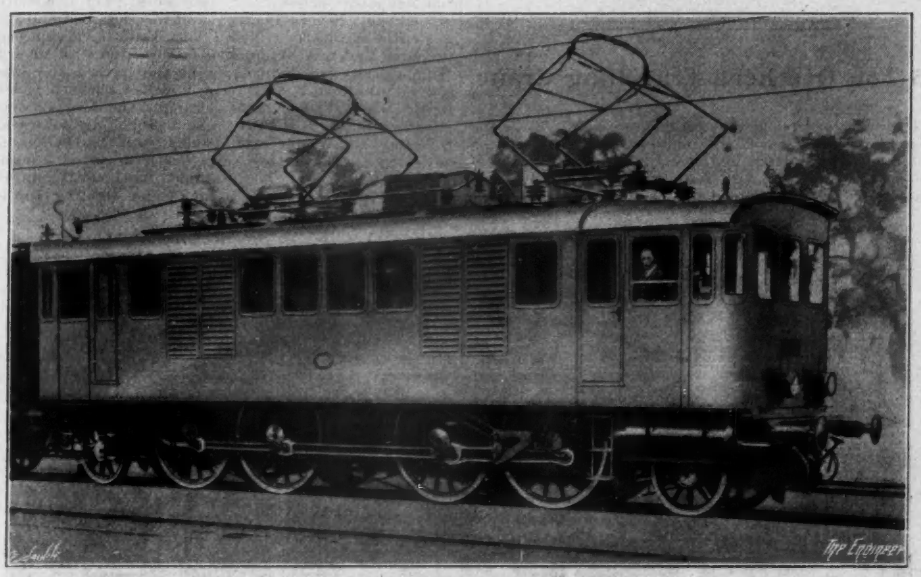


FIG. 6—COMPLETE 2,500 H.P. LOCOMOTIVE

circuit breaker it is taken to the primary winding of the phase converter shown in Fig. 5, in which it is converted into multiphase current at about 1000 volts for feeding the traction motor. This phase converter is substantially a four-pole synchronous machine with several windings and having a rotor of the turbo-generator type, excited by a D.C. exciter E

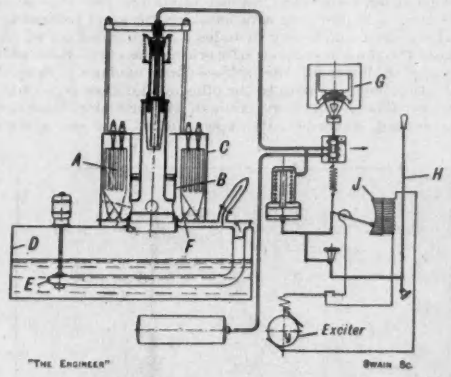


FIG. 7—DETAILS OF LIQUID STARTER

and brought up to speed by a starting motor A. On the stator there are two main windings, a primary 16,000-volt concentric graded winding with one end connected to the supply, the other end being at earth potential, and a secondary winding of the barrel type insulated throughout for 1000/1200 volts. This winding forms a closed ring and is tapped at eight places to give three, four, or six-phase current according to the supply required by the main motor. Another auxiliary winding on the stator acts as a transformer and provides low-tension current for operating the auxiliaries.

The stator windings are completely immersed in oil, one section of the enclosure being composed of a bakelite cylinder which passes through the air gap of the machine and is fitted at one end with an oil-tight expansion joint. By means of a motor driven pump B the oil is circulated through a cooler mounted on top of the machine. The rotor is fitted with thirty-six copper cooling elements C, through which, and through a cooler, water is circulated by means of a

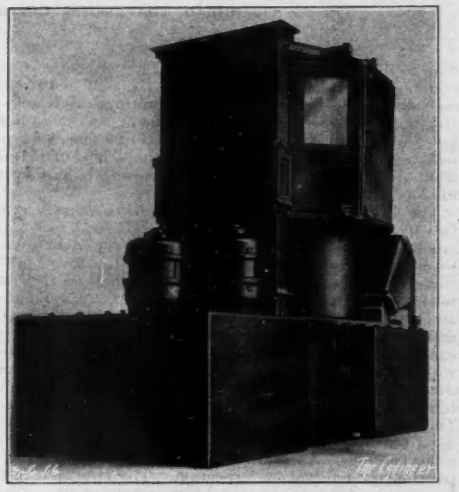


FIG. 9—LIQUID STARTER

pump D, both the oil and water coolers being provided with cooling air by a motor-driven fan.

From the eight terminals of the phase converter conductors are run to a pole-changing switch group which is mounted on the main motor and is shown separately in Fig. 8, where A is a cam shaft, B the servo-motor, and C the shaft that closes the contactors. The switch group comprises five triple and twenty-three double contactors mounted together with substantial arc shields as a self-contained unit. For any desired operation the particular contactors to be closed are first selected by the cam shaft, which is manually operated from the controller, after which they are closed by compressed air, arcing being dealt with by the arc chutes and self-induced blow-outs. The function of the pole-changing switch group is to make the necessary connections between the tappings of the multiphase windings of the phase converter so as to give combinations of 72, 36, 24, or 18 poles corresponding to synchronous speeds of 83, 167, 250, and 333 r.p.m. in either direction of rotation.

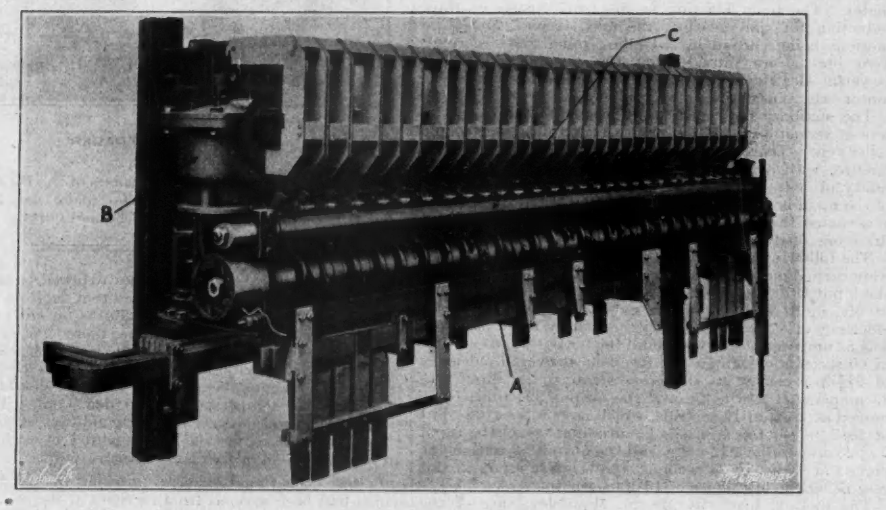


FIG. 8—POLE-CHANGING SWITCH GROUP

A view of a main motor is shown in Fig. 10, whilst Fig. 11 shows the rotor removed from the stator. Contrary to the usual arrangement, the rotor, which has sixteen slip rings, forms the primary of the machine, and the appropriate rings are fed with

FIG. 10—2,500 H.P. TRACTION MOTOR

current by means of the switch group, so as to give the desired pole combination, and thus the desired speed. The stator forms the secondary winding, and in order to avoid the necessity for a pole-changing switch on this side of the motor the winding is constructed so that it is responsive to all the numbers of poles by forming it with 144 sections, which are suitably connected to the 48-pole liquid starter. An electrically operated fan mounted on top of the motor serves to ventilate the machine by drawing air through it and discharging the heated air through the roof of the locomotive. As will be gathered from Fig. 10, the stator is fabricated, and holes have been provided where permissible in order to reduce weight.

The power is transmitted to the coupling-rods of the locomotive driving wheels through side rods

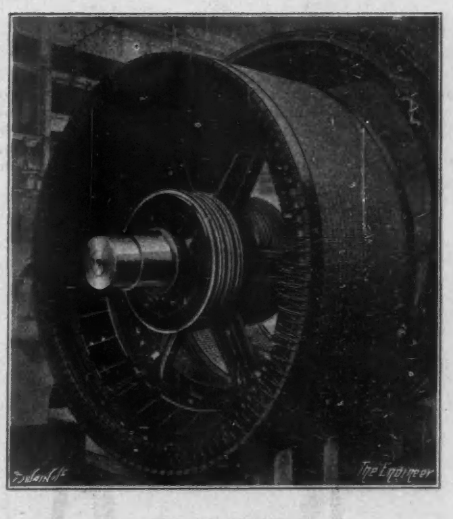


FIG. 11—ROTOR

operating through a Kando triangular driving frame, which, owing to the absence of a second motor, requires a dummy shaft with cranks, as indicated, near the liquid starter. Oil from a reservoir, fed by a pump, is supplied to the spherical three-part bearings by gravity, each of the bearing sections being provided with separate adjustable wedges and screws, so that, apart from ordinary adjustment, by moving one segment more than another the rotor may be re-set centrally in the stator.

To enable the torque of the motor to be regulated in accordance with the speed, a liquid starter, as shown in Figs. 7 and 9, is provided to cut out gradually and short circuit the 48-phase secondary of the motor. The electrodes A of the starter—Fig. 7—are fixed and the extent of their immersion in the liquid is determined by the position of the weir B,

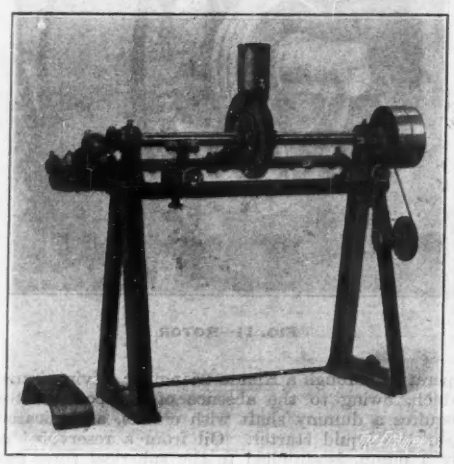
which is raised and lowered by compressed air controlled by a valve in the locomotive master controller. The electrodes are housed in a cylindrical tank C, mounted upon a rectangular vessel D, forming the main reservoir for the liquid. Centrifugal pumps E deliver liquid from the reservoir through nozzles F on to a pointed casting at the end of each electrode, the outlet back to the reservoir being controlled by the weir B. No short-circuiting contacts are provided, but when the weir is in its top position a special arrangement of ducts causes a certain amount of the liquid to be trapped, with the result that it is so heated by conduction that its resistance is greatly reduced. On its way to the nozzles the liquid passes through a cooler supplied with air by the main motor-operated fan.

The master controller is partly automatic. Having decided the speed combination he desires to employ—usually the first, if starting from rest—the driver moves the speed selector to the proper position, thereby setting the speed-controlling switch group (Fig. 8) in the correct position for closing. He then operates the handle of the speed-control lever and the switch group closes on the appropriate contacts, while on moving a second control lever H (Fig. 7) the excitation of the phase converter is raised until the locomotive starts. Immediately the train begins to move, a relay G comes into play and causes the liquid starter to cut out resistance at a rate which maintains the kilowatts supplied to the motor at a constant value and corresponding to the excitation of the phase advancer, thus giving high efficiency and practically unity power factor. By operating the lever H the shunt rheostat J of the exciter is simultaneously moved to a suitable position. As soon as the locomotive reaches full speed the demand for power is reduced and another automatic device inside the controller comes into play and reduces the excitation of the phase converter to a value corresponding to the kilowatts required to drive the train at constant speed, but in the event of the load increasing, owing to a gradient, the controller automatically increases the excitation. A small amount of hand adjustment of the excitation is, however, possible, in order to control the power factor when necessary. To proceed to the next speed the driver has only to switch off and repeat the operations with the speed lever set to the next combination, the system being designed so that the switch group cannot close again until the full amount of resistance has been re-inserted in the secondary circuit of the motor.

The first passenger locomotive began its trials on May 6th, and the second on June 17th, 1932. After these trials both engines were painted and put into intermittent service on August 8th, while on September 12th they were put into regular service. Since that time both locomotives have run on alternative days two and three double trips of 60 miles out and back, each averaging 300 miles a day. The first goods locomotive completed its scheduled tests on October 27th, and is now in regular service, whilst the construction of the second goods engine has just been completed.

Lawn Mower Grinder.

THE accompanying illustration shows a new type of lawn mower grinder, which has been recently placed on the market by Samuelson and Co., Ltd., of Britannia Works, Banbury. It is built in two sizes, the smaller taking cylinders up to 24in., and the larger up to 30in. long. With the help of suitable bushes, the cylinder to be ground

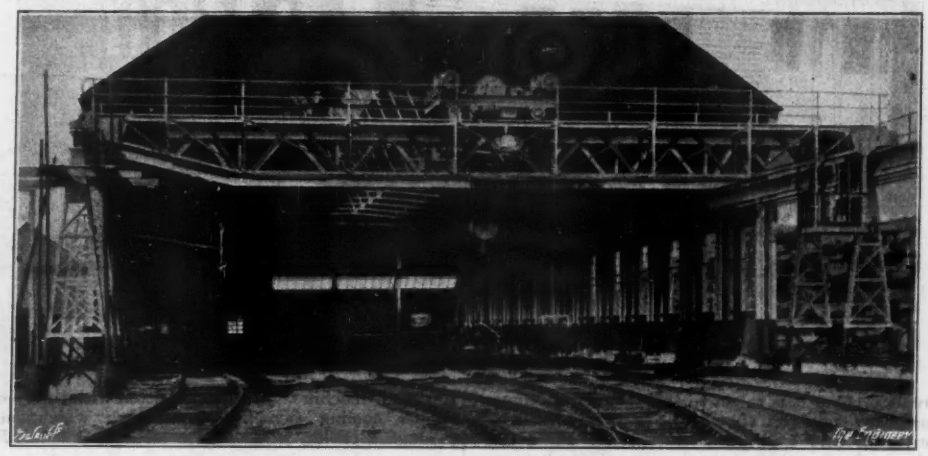


LAWN MOWER GRINDER

is mounted between two headstocks, which are adjustable on the bed, as seen in our illustration. These headstocks have fine transverse adjustment with indexes. For grinding a ledger plate a special rest is supported between the centres adjusted to the grinding angle desired. The wheel is traversed automatically along a splined shaft by a feed screw at the back which is reversed by a tappet rod. The Bauxalite grinding wheel is arranged for either wet or dry grinding, and it is supported by flanges which are in accordance with the latest safety regulations. The machine runs at 400 r.p.m. All running shafts have renewable split brass bushes, and the gearing is of phosphor bronze. The illustration shows very clearly the drive for the headstock spindle. The makers claim that the new machine, which is lower in first cost than machines not specially designed for the purpose, embodies good machine tool practice, and is quicker in operation than improvised grinders often used for lawn mower work.

25-Ton Overhead Travelling Crane.

THE accompanying illustration represents a 25-ton electric overhead travelling crane constructed by Joseph Adamson and Co., Hyde, to the requirements and specification of the Great Western Railway Company. It has a span of 73ft., a wheel base of 15ft., and a distance from the floor to the gantry rail of 20ft. 7in. The space between the gantry rail and the nearest point of the roof is 7ft. 5in., and the end clearance 12in. The operating speeds are :—Hoisting, 12ft. per minute for full load ; auxiliary hoist by separate barrel and motor for a load of 5 tons, 60ft. per minute ; longitudinal travel speed with full load of 25 tons, 200ft. per minute ; and cross traverse of the crab with full load, 75ft. per minute.



OVERHEAD TRAVELLING CRANE FOR GREAT WESTERN RAILWAY

The bridge is of the four-girder lattice type, having two main girders on which the crab runs and two outer auxiliary girders, which are reinforced to the main girders to ensure a rigid box section for lateral stiffness. The travel runner is made as a complete unit built on the shaft so that it can be easily taken from the carriage, examined, and re-fixed. The axle, which is of the fixed type, is carried in heavy bearing supports in the carriage side, the carriage being slotted so that the axle can be withdrawn without disturbing the crane or taking the combined runner and axle to pieces. Inside the runners have roller bearings and a ball thrust bearing which are dustproof. The cross shaft connecting the driving runners is operated by a centre drive and is also supported by and runs in roller bearings. All shafts in the crab can be lifted out of position for renewal or inspection. The two main hoist barrels are driven by independent reduction gears, each on its own shaft, the return pulleys being mounted one on each of these shafts. These barrels revolve on the shaft and not in separate bearings.

The main load of 25 tons is carried on eight falls of flexible steel wire rope, 2¾in. circumference, having a breaking load of 21·9 tons per rope, which gives a factor of safety of 7. In order to give long life to the ropes the main barrel and the block sheaves are made 26½ times the rope diameter. The main hoisting mechanism consists of three reductions of spur gearing, the first, second, and third motions being carried in swivelling roller type bearings. Two brakes are provided on the hoisting motion, a powerful electric brake and a centrifugal brake on the motor extension shaft.

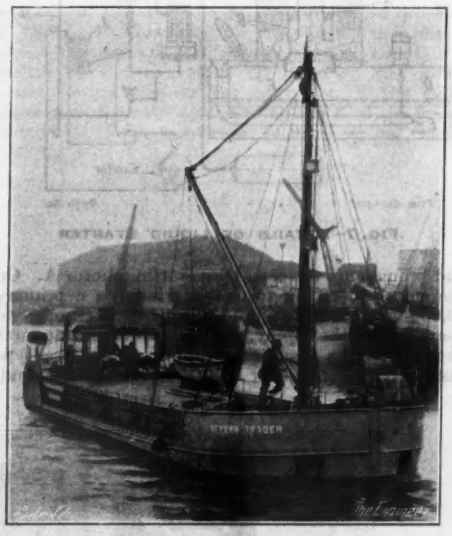
The auxiliary hoisting motion is actuated through two sets of reduction gear, the shafts being of the swivelling roller type. There are four falls of wire rope, 1⅞in. circumference, with a breaking load of 9·3 tons and factor of safety of 7·4. Two brakes are also fitted as in the case of the main hoisting motion. The cross traversing motion is actuated through two reductions of spur gearing, which drive one of the axles spanning the bridge.

The following are the results of some of the tests which were carried out on the crane :—On the main hoist motion the input was 81 ampères at 232 volts, the output 25 tons at 6ft. in 32 seconds, which gave a mechanical overall efficiency of 87 per cent.; on the auxiliary hoist the input was 83 ampères at 230 volts, and the output 5 tons at 60ft. in 60 seconds, which gave a mechanical overall efficiency of 91¼ per cent.; on the cross traverse the input was 13 ampères at 246 volts, and the output 32½ tons, being moved at 25ft. in 13 seconds, which gave a tractive effort of 28·7 lb. per ton ; on the longitudinal travel the input was 25 ampères at 242 volts, and the output 58 tons, being moved at 100ft. in 24 seconds, the tractive effort in this case being the low figure of 15·9 lb. per ton.

The motors, made by Messrs. Mawdsleys, are of the totally enclosed series-wound reversing type, the speeds and horse-powers being as follows :—Main hoist, 26 H.P. at 650 revolutions per minute ; auxiliary hoist, 26 H.P. at 650 revolutions ; cross traverse, 5 H.P. at 650 revolutions ; longitudinal travel, 13 H.P. at 650 revolutions. The control gear of the drum type was manufactured by Allen, West and Co., Ltd., and the bearings throughout are of Hoffmann manufacture fitted in special housings by the makers of the crane.

Motor Vessel for Canals Service.

THE Severn and Canal Carrying Company, Ltd., of Birmingham, which operates a regular service to and from the Bristol Channel ports, has put into service a new type of motor vessel, which has been specially designed for the company's canal and Severn work. The new ship is named the "Severn Trader" and was designed and built in Bristol by Charles Hill and Sons, Ltd., the design being prepared by Mr. A. W. Peck, in conjunction with Mr. C. P. Hinman, the traffic manager of the Severn and Canal Carrying Company, Ltd. The hull has a length of 90ft. with a beam of 20ft. and 7ft. draught, the designed speed given by the 120 B.H.P. Kromhout propelling motor being 8 knots. The engine is controlled from the cockpit, the necessary engine controls being neatly arranged alongside the steering wheel. The auxiliary machinery comprises a generator and an accumulator for lighting service. Forepeak and aft water ballast tanks are provided with the necessary pumping arrangements for good ballasting, and the deck machinery includes a winch windlass which serves the double purpose of working the cargo hoist and raising or lowering the self-stowing anchors. Special attention has been paid to the officers' and crew accommodation. The preliminary trials of the new ship have, we understand, exceeded all expectations, and she should



THE SEVERN TRADER

prove of considerable service to traders of the Birmingham and Wolverhampton districts who make use of water transport services to the Bristol Channel ports.

IT is, says *Machinery*, sometimes required to deep-etch high-speed steel. It should be noted that deep acid etching will give just as satisfactory results as on carbon steels, but the high-speed steel will require more time in the acid to give the best results. The best deep-etch solution to use is 1 : 1 hydrochloric acid diluted from the concentrated acid with distilled water. The acid should be kept at a constant temperature of 90 deg. Cent. The time element depends entirely on the condition of the steel. Hardened steel requires a longer period of etching than an annealed steel of the same composition.

IT has been found that ivy growing on old buildings which had been severed from its roots in the soil, months or even years previously, still flourished. Apart from the mechanical action of large stems and roots, the chemical action of the secretion by which the fine root hairs obtain their nutriment causes the disintegration of mortar. The damage done by ivy to old buildings in this country has often been commented upon, and it is of interest to recall that Sir Martin Conway some years ago noted that the spread of this plant has very greatly increased in the South of England during the last 100 years.

The "Standage" Resilient Coupling.

DURING a recent visit to the Precision Works of Standage Power Couplings (England), Ltd., at 100, Blackstock-road, London, N.4, we inspected in course of manufacture, and also under test, various designs of the new resilient coupling illustrated herewith, which has been invented and patented by Mr. C. A. G. Standage, to work with directly coupled machines and prime movers. In considering the design of a flexible coupling it should be borne in mind that the primary object of any such device should be to protect the machines from any deleterious effects which may possibly arise through the misalignment of the connected shafts, sudden shock loads, high peak torques, or accidental overloads. Any one of these conditions, or all of

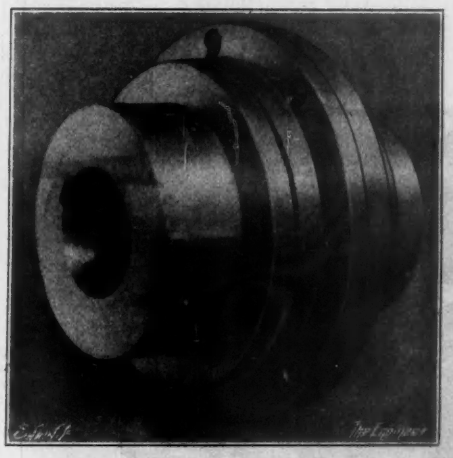


FIG. 1—TYPICAL "STANDAGE" COUPLING

then., may occur in every plant, and a coupling should therefore possess the requisite features and degree of resiliency to cope with them. The Standage coupling, it is claimed, meets all these conditions, and it differs from other flexible couplings we have hitherto seen and described in its employment of bridging members of a simple laminated form, which are die-stamped from spring steel, and can be annealed and tempered to the required degree of hardness, and in special cases finally ground to very fine limits. Generally, an alloy steel is used having a tensile strength of from 90 to 100 tons per square inch, with a Brinell hardness number of between 403 and 444 for the finished spring. Fig. 1 shows the external view of a typical coupling. The drawing of a turbine type of coupling reproduced in Fig. 2 clearly indicates the principles of construction, and these are further shown by the halved coupling illustrated in Fig. 4. It will be seen that the type of spring member employed enables a widely varying degree of resiliency to be obtained by the grouping together of pockets of either thick or thin springs, which, while altering the torsional stiffness of the coupling, do not impair its ultimate strength, as the toothed members embracing the spring packets are not altered. Furthermore, the spring packets—see Fig. 2—are supported by end rings with a beaded rim, which corresponds to a recess punched in the spring at either end. The method of locating the spring packets is such that they float within the enclosing casing and rotate about the same axis as the driving hub. Arrangements are made by means of oil valves and oil ways to keep them well lubricated, any escape of oil being prevented by felt rings in the cover flanges or hubs. In order to provide the necessary accommodation for misalignment and end float, the cover of the couplings, as shown in Fig. 2, is a push fit over the driving hub teeth, the cover of the driven side being recessed to give the required clearance to enable misalignment to be accommodated, while the end clearance between the driver and driven parts of the coupling gives end float. Our engravings illustrate some of the varied types of coupling which have been designed to meet different conditions of operation. Fig. 1 represents a typical coupling for a 390 B.H.P. motor-driven air compressor, while the left-hand view in Fig. 3 shows a fly-wheel type of coupling, which has been supplied for War Office mobile generator sets. The right-hand view in Fig. 3 illustrates a heavy coupling for rolling mill work, which is fitted with the Tecalemit "One-Shot" lubrication system. As previously mentioned, the coupling shown in

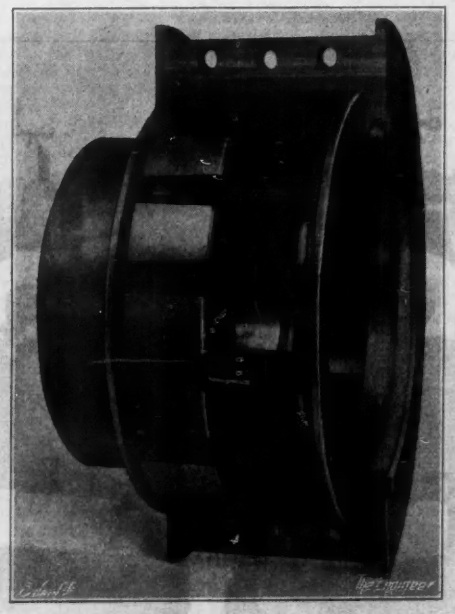
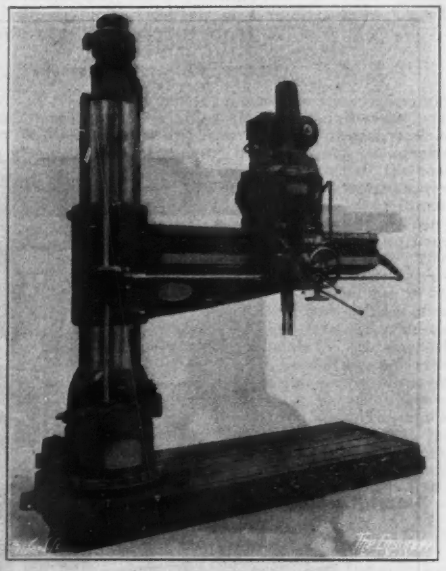


FIG. 4—COUPLING WITH HALF COVER REMOVED

Fig. 2 is for use with a steam turbine, and it has a capacity of 300 H.P. with a total end float of $\frac{1}{8}$in., an axial malalignment capacity of $\frac{1}{32}$in., and is capable of accommodating 2 deg. of angularity, these conditions being called for simultaneously. The coupling shown in Fig. 4 is of the axially split cover type, which can be usefully employed in cases where end space is limited. This pattern of coupling has been supplied up to 300 H.P. capacity for paper mill drives. The firm has standardised a range of over forty couplings from fractional horse-powers leading by small steps up to 3000 horse-power, with special designs for higher powers. Its experience with hitherto difficult forms of drives has shown the great advantage of the laminated spring members, which can be varied in such a way as to enable the resilient strength of a coupling to be adjusted to meet the most exacting conditions for a given form of drive. We also inspected under test a form of resilient universal joint of the laminated spring member type, which is applicable in different forms to transport vehicles, steam locomotive valve gear, and sugar mill and cement mill drives. In general, this application of the patented coupling provides a certain amount of end movement without interfering with the synchronous torsional properties of the drive. We were given to understand that some important developments in this connection are approaching completion, and we hope to deal more fully with them in a later article.

Motor-Driven Radial Drilling Machine.

THE accompanying engraving illustrates a 7ft. radial drilling machine recently produced by Kitchen and Wade, Ltd., of Halifax. The machine is also made in 6ft., 8ft., 9ft., and 10ft. sizes. Its characteristic feature is the use of a 3 horse-power motor mounted at the top of the column for elevating the arm and of a 7½ horse-power motor mounted on the saddle for driving the spindle. In addition, a small motor is fixed at the base of the column for driving the cutting fluid pump. The spindle may be run at any one of eighteen speeds, ranging from 580 to 27 r.p.m., the changes being made by means of two selecting levers on the saddle combined with single and double back gearing. Eight changes of power feed extending from 36 to 150 cuts per inch are obtained through gearing controlled by two handles on the saddle. An automatic trip motion is provided for the feed to permit holes to be recessed or drilled to a given depth. A quick adjustment for the spindle and a sensitive hand feed are also provided. By means of a single lever on the left-hand side of the saddle the saddle can be locked to the arm and the arm to the column. The weight of the spindle is balanced by a spring device. The machine can drill holes up to 3in. diameter in steel and 3¼in. in cast iron, and can tap holes up to 2in. Whitworth or 4in. gas. It can also be used for boring and trepanning.



RADIAL DRILLING MACHINE

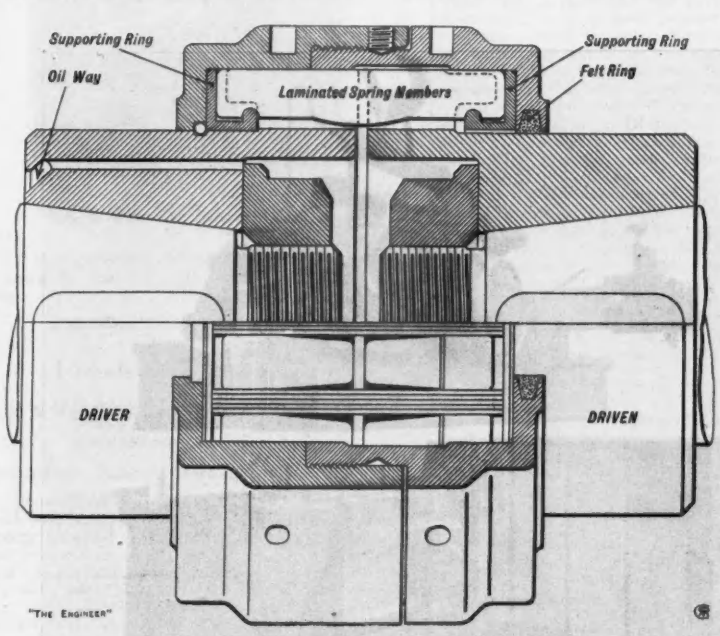


FIG. 2—COUPLING FOR STEAM TURBINE

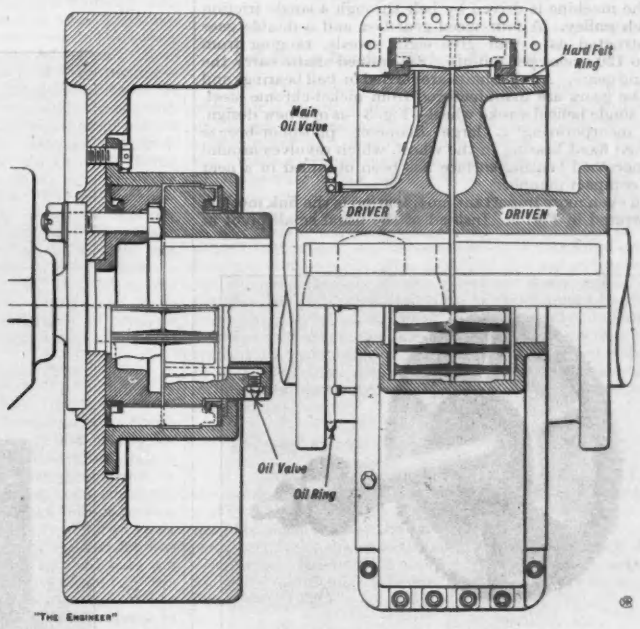


FIG. 3—FLYWHEEL AND ROLLING MILL COUPLINGS

IN a paper which he read before the Society of Chemical Industry, in Bristol, Mr. N. Swindin described various methods of lining vessels with rubber. He said that in the case of old tanks with wet, uneven and rusty surfaces it was found that a cement composed of stabilised emulsified rubber, Portland cement, and sand (E.P. 275,316) could be applied to a wet surface, and when set formed an excellent bed upon which to apply the sheet. It was his custom to apply this cement in all cases of lining on the site in the open air. Even if the tanks leaked or had holes in the walls, the cement filled them up. Many an old tank was, he said, now in service as an acid container.

Two Interesting Shapers.

THE 18in. stroke crank shaper illustrated by the two photographs reproduced in Figs. 1 and 2 on this page has recently been put upon the market by the Butler Machine Tool Company, Ltd., of Halifax, and has a number of novel features. A glance at these illustrations is sufficient to show how strongly constructed is the body of the machine to withstand all the stress and twist of the drive when cutting. As compared with earlier machines of this type, the section of the V slides and the length of the saddle have been increased.

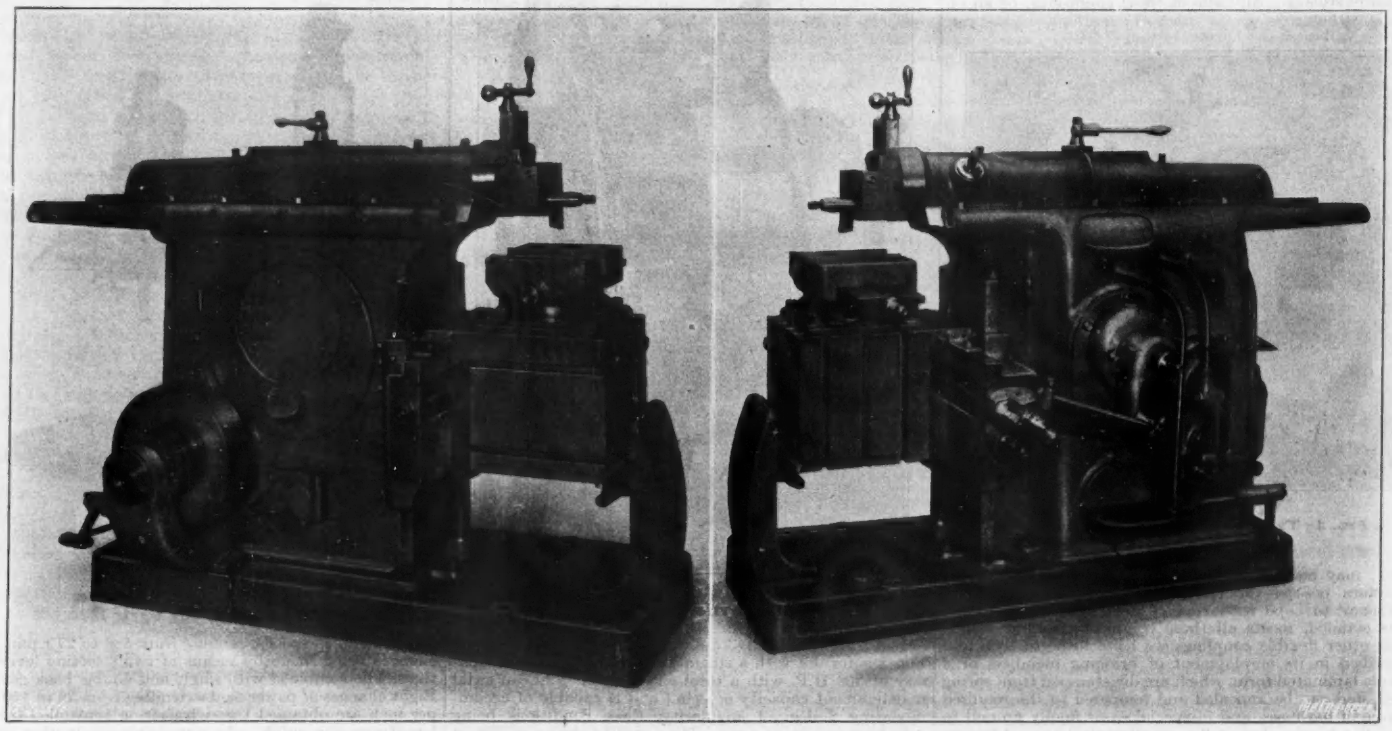
The machine is driven by belt through a single friction clutch pulley. A four-speed gear-box and a double gear constructed as a unit give eight speeds, ranging from 10 to 120 cycles per minute. Six-splined shafts carry the sliding gears. All the shafts are carried on ball bearings and all the gears are manufactured from nickel-chrome steel. The single helical stroke wheel—Fig. 3—is of a new design. By incorporating a large diameter phosphor-bronze bushed fixed bearing in the wheel, which revolves around it, increased bearing surface has been obtained in a neat and compact manner.

An even more important modification is the link motion, illustrated in Fig. 5. Instead of the usual small pivot at the bottom of the slotted link, a large diameter trunnion acts as a pivot. This trunnion has a large hole bored across its axis, while the link has a round shank at the lower end, which is a sliding fit in the cross hole. Thus the upper end of the link may be attached directly to the ram and the usual connecting-rod between the link and the ram is no longer required. The arrangement eliminates two pin joints that might give rise to trouble. But the design introduces more advantages than the mere elimination of two joints. The link is suspended freely from the ram instead of being poised on a small pivot, while, since the trunnion mounting is not constrained sideways, the link is free to find its own centre and is not subjected to twisting stresses. The makers regard the new mechanism as of great importance and claim that by its use higher speeds may be used and cutting efficiency increased.

Adequate lubrication is a necessity if machine tools are to have a long life, and this feature has been carefully studied in the design of the machine under review. A sump in the base forms the reservoir for the oil, which is distributed by a gear pump to all the working parts. The cascade system has been adopted for the gearing and the trunnion mounting of the link, while oil flows to the sliding ways by wick feed from wells in the ram strips. For the protection of the slides there are guards at the back of the machine, while felt wipers are fitted at the front. Similarly, the table slides have been protected as far as possible.

Referring again to the illustrations Figs. 1 and 2 above, it can be clearly seen that the horizontal and vertical feeds are operated from a slotted disc and a ratchet wheel. The feed screw has two leads, and is fitted with ball thrust bearings at each end. Six feeds are available, ranging from six to seventy-two cuts per inch. Another feature worthy of comment is the arrangement of the control levers, all together, and as near as possible to the working position. The two gear levers operate in a simple gate change plate and the starting lever actuates a quick-acting brake which rapidly stops the movement of the ram. When the machine is designed to be electrically driven the motor is mounted on an extension of the base-plate at the back of the machine and a "Texrope" drive transmits the power to the friction clutch.

Another illustration—Fig. 4—shows a larger machine designed primarily for use in heavy forge shops for re-truing the anvil seatings of hammers and presses, and is designated a 48in. portable draw-cut shaper. The bed is made in two parts. The top part, as shown by Fig. 4, carries the saddle and all the working parts of the machine and may be transported at will, the bottom bed being left mounted on the foundation. Eight large bolts hold the two parts together. The ram is operated by a 15 H.P. reversing motor, the generator, starter, and control panel for which are mounted on a separate portable base plate. Suitable lengths of armoured cables enable the machine to be driven from wall plugs. The reversing motor drive provides a wide



FIGS. 1 AND 2—BUTLER 18-INCH STROKE CRANK SHAPER

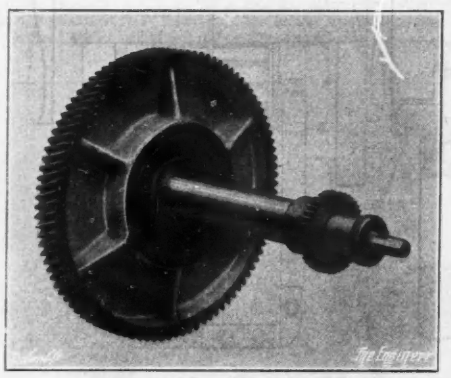


FIG. 3—SINGLE HELICAL STROKE WHEEL

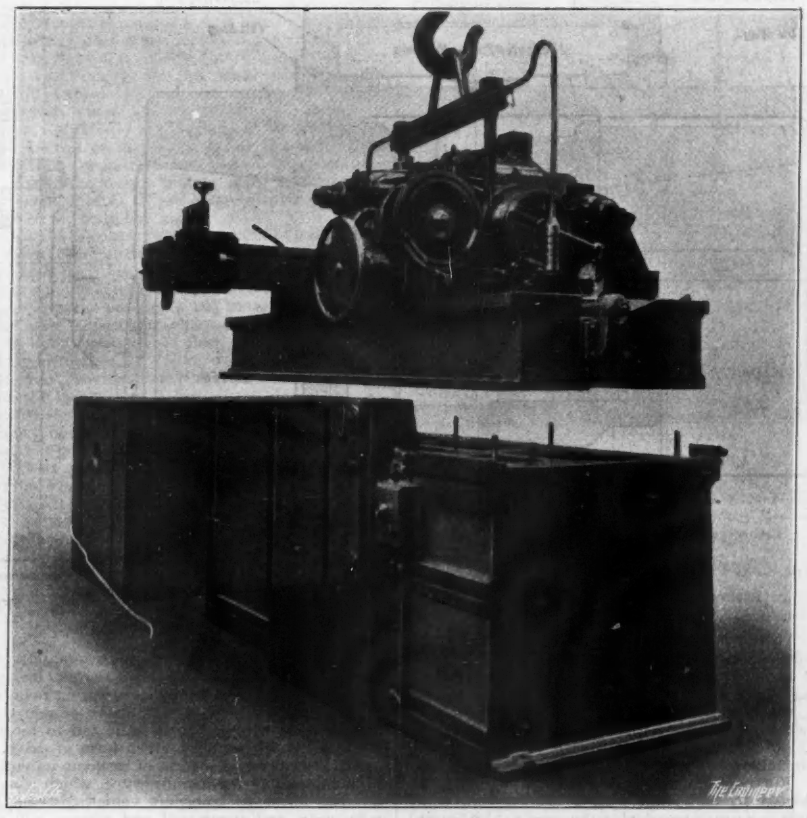


FIG. 4—48-INCH PORTABLE DRAW CUT SHAPER

range of speeds from 20ft. to 70ft. per minute cutting and from 40ft. to 80ft. per minute returning. The large dial illustrated in Fig. 6 is mounted at the front of the machine and is fitted with dogs by means of which reversal is

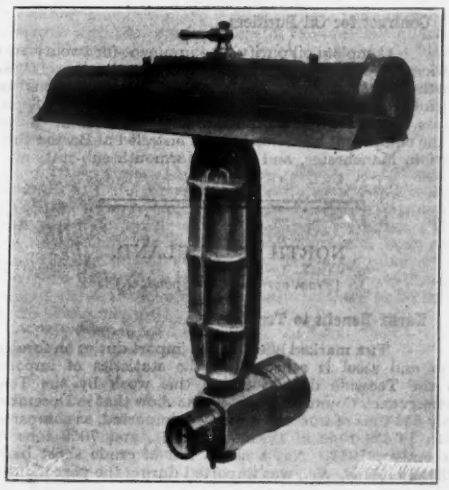


FIG. 5—LINK MOTION

brought about. These dogs are adjustable around the dial, which is marked off in inches of stroke, and operate the reversing switch through tappets. Reversal may also be brought about by the use of the hand lever below the

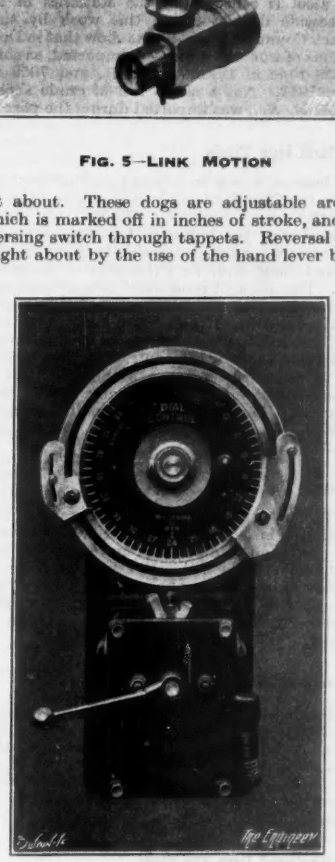


FIG. 6—STROKE CONTROL DIAL

dial. A 2 H.P. reversing traverse motor, which moves the saddle along the bed, is operated from a portable pendant control.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Birmingham Quarterly Meeting.

THE January quarterly meeting of the Midland iron trade was held in Birmingham yesterday—Thursday. Consumers seemed to be much more confident as to an increase in their requirements in the immediate future, and in a number of instances, particularly in the raw iron branch, users have already contracted for supplies over the first three months of the year, while isolated cases of contracts over the half-year are reported. Probably there has been more readiness to buy than to sell a long way forward as regards some of the consuming branches. Industry in the Midlands is now fully back at work and manufacturers state they are convinced trade has reached its lowest ebb. They look with confidence for a gradual expansion of business and hope to have many more hands engaged, and more active plant, at the end of the quarter than they have at date. It is admitted that the start has been slow, but they visualise a general speeding up as the year progresses. Judging by the attitude taken up by sellers of iron and steel, there is little likelihood of any material alteration to selling prices as a result of the quarterly meeting. Up to the time of writing quotations were unaltered in all branches of the market. There was some wavering, however, in the small steel bar department, where rollers fear a serious renewal of the foreign invasion, Continental prices having fallen week by week since just before Christmas. Local re-rollers are making a very serious effort, however, to maintain their rates as lately ruling.

Steel.

Business in the finished steel market continues dull, and until there is an improvement in activity at the heavy engineering works in this area, it is likely to remain so. Midland constructional engineers continue unemployed, except for small contracts which provide very little support to the steel rolling mills. There is keen competition for all structural work, especially as the number of firms in this industry has increased considerably in the last few years. Specifications for steel for use in wagon building are also very meagre, and there is no sign of any expansion under this head. There is a fair amount of steel on order by the makers of tanks used for storage and other purposes, while automobile engineers are regular purchasers of special steels used in the industry. In the heavy steel trade specifications are at date mainly for small quantities. Selling prices are controlled by the Steelmasters' Association, and the basis agreed upon is firmly adhered to. Angles are quoted £8 7s. 6d., with a rebate of 15s. per ton to purchasers confining themselves to British steel. Tees are £9 7s. 6d., less 15s. rebate; joists, £8 15s., less 22s. 6d.; ship, bridge and tank plates, £8 17s. 6d., less 15s. Boiler plates, prices of which are not subject to control, sell at £8 5s. upwards. In the half-products department, Staffordshire re-rollers have improved their position, having booked a substantial amount of work as a result of the increase in foreign prices a month ago; but the recent relapse is a depressing factor in the situation. Rollers of small steel bars and strip were congratulating themselves that foreign supplies were nearing the point of exhaustion, and they were hopeful of securing really valuable business at recent prevailing buying rates. The foreigner has rushed headlong into the market again, cutting quotations right and left, so that local re-rollers are once again out of the running as regards price. Continental steel bars are quoted at as low as £5 15s. against the Staffordshire makers' price of £6 15s. Many consumers have placed orders with English mills which will cover their early requirements. A number of South Staffordshire re-rollers have a substantial amount of work before them which was diverted from Continental suppliers owing to the relatively favourable prices ruling in this country. The probability, therefore, is that consumers will not re-enter the market for some time, being content to take delivery of the steel ordered from the local works as well as that bought abroad. There is no change in the billet situation. Native prices are controlled at £4 17s. 6d. to £5 7s. 6d., while the foreigner is said to be endeavouring to re-form the Cartel which previously existed, and set prices and outputs on the Continent. The steel scrap market, while still quiet, appears to have turned the corner as far as prices are concerned, following the better inquiry from Welsh steel works, where activity has recently been on an improved scale. Consumers, however, are anxious to make contracts on the old low scale of prices, and the merchants on their part are holding out as long as possible for more remunerative values. They ask at least 30s. per ton, but consumers offer 27s. 6d. at most.

Pig Iron.

Midland blast-furnacemen have sold large quantities of iron over the current quarter; indeed, in some cases, it is said that production at some of the furnaces at the present rate is fully taken up. There are still stocks at the furnaces to be disposed of, however. There can be no doubt but that Midland foundry iron is well sold over the next quarter, and in some instances contracts extend to June. Furnacemen would, however, be better pleased if requisitions would assume more firmness. It is reported that in one or two instances specifications for this quarter are larger than those of a year ago. The tone of the market is decidedly hopeful, and smelters alike in Derbyshire and Northamptonshire are in a better position than they were. Demand continues chiefly for foundry grade material, forge sorts being exceedingly slow of sale. Prospects of an early recovery in the forge branch are not very bright. The call for basic pig continues rather slow. Selling prices as recently reaffirmed by the Central Pig Iron Producers' Association were quoted on 'Change in Birmingham this week, and sales were made at those figures. Northamptonshire No. 3 foundry sells at £3 2s. 6d., forge at £3 1s., Derbyshire and North Staffordshire No. 3 foundry at £3 6s., and forge £3 1s. These prices are per ton delivered to stations in the Black Country, and are subject to special rebates in the case of large buyers.

Finished Iron.

The position of the finished iron mills in South Staffordshire shows little change. Orders are mostly for small quantities, and works are not booked more than a week or two ahead. Ironmasters report that work at present available is just sufficient to keep men employed about three or four days each week. They do not profess to see ahead of them anything likely to lead to an early recovery, and, accordingly, this branch of the market was less optimistic than others. Makers of marked bars are in the best position, but they are closely followed by the producers of tube strip. The Crown and common bar branches come slowly up behind. There is no change in selling values, makers maintaining that there is nothing to be gained by interfering with present rates. Marked bars command £12 at makers' works, Crown bars £9 upwards delivered, nut and bolt bars £8, fencing bars £7 15s., and tube strip £10 7s. 6d. to £10 10s.

Galvanised Sheets.

There is no change in the position of the galvanised sheet industry on the week. Demand from overseas is slow to materialise, and home requirements keep on a normal level. Selling rates are maintained on the basis of £10 10s. f.o.b. for export, and £11 15s. upwards delivered for the home trade for 24-gauge corrugated sheets. Black sheets are £8 10s. for export, and £9 10s. upwards for home consumption.

Work for Midland Engineers.

The Sunbeam Motor Car Company, Ltd., of Wolverhampton, has received an order for fifteen trolley omnibus chassis from the Walsall Corporation. The value of the order is put at £17,250. Derby Corporation, which already operates twenty Guy six-wheeled trolley omnibuses, has just placed a repeat order with this Wolverhampton firm for another twelve vehicles. The chassis will be fitted with the Guy patented 75 H.P. compound-wound regenerative motor. This type of motor has been successful in all parts of the country, and in his last report, Mr. Bancroft, general manager of the Derby Corporation Transport Department, stated that the fleet average of the twenty Guy trolley omnibuses was only 1·88 units per car mile. Liverpool Transport Committee has recommended the City Council to accept the tender of the Electro-Mechanical Brake Company, Ltd., of West Bromwich, for fifteen car sets of bogie trucks and equipment, including Crompton Parkinson motors at the revised price of £995 per car set, and in the event of the Corporation finding the trucks and equipment satisfactory after a prolonged test, to place another order with the company for fifteen further car sets at a total price of £26,850, or at the rate of thirty car sets at £895 each.

Coalowners Oppose Amalgamation.

In a recent report on conditions in the Cannock Chase coalfield, I remarked that the mineowners were not inclined towards a scheme of amalgamation such as they had been called upon by the Coal Mines Reorganisation Commission to prepare. I now learn that the coalowners in this area are definitely opposed to reorganisation in the shape of amalgamation, and they have now informed the Government Commission that they refuse to carry out the instructions of the Commission to prepare a scheme of amalgamation under the Coal Mines Act, 1930. They contend that the proposals submitted to them by the Commissioners are impracticable and undesirable in the interests of all the parties concerned, and will be of no advantage to the industry. It now remains with the Commission to frame its own scheme for the Cannock Chase coalfield. Before any scheme can become operative it has to be established that it is in the national interest, that it will result in lowering the cost of production or disposal of coal, and that the terms are fair and equitable to all persons affected thereby. This means that the coalowners of Cannock Chase will have ample opportunity of stating their case against the Commissioners' scheme, and the prospect is of a very determined conflict between the two parties.

Unemployment.

The Midland division showed up fairly well in the latest official returns of unemployment, for there was a substantial decline on the previous month. Details show that on December 19th last the number of unemployed were 249,137 wholly unemployed, 98,788 temporarily stopped, and 489 normally in casual employment, making a total of 348,414. This was 5080 fewer than the number on the register on November 21st, 1932, and 9316 more than a year before. The total on December 19th, 1932, comprised 278,788 men, 6198 boys, 59,103 women, and 4325 girls.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Awaiting a Russian Trade Agreement.

THE hopes of many Lancashire engineering concerns for a return of reasonably active trading conditions are largely centred upon a new trade agreement between this country and Russia. Machine tool makers, textile machinists, electrical engineers, and firms in other branches of engineering in this district in the past have carried out contracts on Russian account which have represented a substantial value in the aggregate. A formidable obstacle to the placing of fresh business by Russia arose in the second half of last year in consequence of restricted credit facilities and—shortly after this difficulty was overcome—by the cancellation of the previous trade agreement between the two countries. One or two Lancashire firms have important Russian work in hand already, and there are expectations among others that further important contracts for a wide range of engineering products are waiting to be placed. This, however, is not likely to be done until a new and mutually satisfactory agreement has been reached.

Dividend Arrears Paid.

An improvement in conditions is indicated by the announcement made by the directors of L. Gardner and Sons, Ltd., oil engine manufacturers, of Patricroft, near Manchester, that the arrears of dividend on the 7 per cent. preference shares of the company are to be paid. The distribution amounts to 4s. $10^4/_3$d., a sum representing $3\frac{1}{4}$ years' dividends, thus clearing off the arrears up to June 30th, 1932.

Contract for Benzole Plant.

A contract for two installations of benzole extraction plant has been placed by the Manchester Corporation gas department with Simon-Carves, Ltd., of Cheadle Heath, near Manchester. One is to be installed at the department's Bradford-road works and the other at the Partington works. A similar plant is already working, and the total capacity of the three is expected to be in the neighbourhood of 500,000 gallons a year.

New Plant for College of Technology.

The gift of a complete installation of opening and blowing machinery has been made to the College of Technology, Manchester, by Textile Machinery Makers, Ltd., the combine of Lancashire textile machinery manufacturers. The formal presentation of the plant is to be made to the governors of the College on January 20th.

Colliery to Reopen.

A welcome indication is the news that the Ellerbeck Colliery, Chorley, which was closed down several months ago, is to be reopened shortly under new manage-

ment. Many of the 300 men who were formerly employed there will be restarted as soon as active working operations are resumed.

Obituary.

Mr. T. A. Walker, head of the firm of Walker Brothers (Wigan), Ltd., Pagefield Ironworks, Wigan, has died at his home at Southport at the age of eighty-eight years. Mr. Walker, who was well known in the engineering world, with his brother, Mr. J. S. Walker, founded the firm in 1866. Ventilating equipment was one of their leading specialities. They were responsible in 1886 for the ventilation of the Severn Tunnel, and when new plant was installed about twelve years ago Walker Brothers secured the contract. One of their biggest contracts was in connection with the new Mersey tunnel, now approaching completion. Much of their work has been connected with mining installations.

Non-ferrous Metals.

Experience on the non-ferrous metals market during the past week has been by no means satisfactory. For the most part copper has displayed easiness, but the loss sustained early on was made good in the later sessions. A more or less simultaneous contraction of selling pressure and some improvement in the volume of inquiry, more especially in respect of forward positions, resulted in a recovery from the low price levels touched, values current at the moment of writing representing an increase on balance for the week of about 2s. 6d. per ton for standard brands. The tin section has shown pronounced weakness at times, although present prices are appreciably above the worst. The partial recovery, however, was due less to any accession of buying interest than to official support of the market, the loss on balance being in the region of £1 10s. per ton. Bearish influences in the statistical position of the metal, coupled with a restricted trade demand, have exerted considerable pressure on the lead market, and values have given way to the extent of 10s., thus bringing prices back to where they were about midway through 1932. In sympathy with other sections and on selling by speculators spelter has shared in the prevailing weakness and is about 5s. per ton cheaper on the week.

Iron and Steel.

The Lancashire iron and steel markets have been slow to register any improvement and business this week has been quiet. Sellers are hopeful of better things as matters settle down again. Pig iron sales are largely limited to early delivery needs, but prices are steady at 67s. per ton for Staffordshire, Derbyshire, and Cleveland makes, 65s. 6d. for Northamptonshire, 62s. for Derbyshire forge, about 82s. for Scottish foundry, and 81s. for West Coast hematite. Finished iron is in quiet demand, but values are maintained at £10 5s. per ton for Lancashire best bars and £9 15s. for Crown quality material. Buying operations in the steel market are slow, especially in the heavy branches, constructional engineers being particularly badly placed. Some slight expansion compared with last week has, however, been reported in the case of alloy steels. Joists are quoted at £8 15s. per ton, sections at £8 7s. 6d., general plates at £8 17s. 6d., boiler plates at about £8 10s., large-diameter bars at £9 7s. 6d., and small re-rolled descriptions at about £6 15s. An easy tendency is still in evidence in the Lancashire markets for Continental materials, and most of the recent advances have been lost.

BARROW-IN-FURNESS.

Hematite.

The market for this district's hematite pig iron is quiet, but steady, and there is every prospect of a much better run of trade than was the case up to a short time ago. Smelters who have their own steel plant are using up a good proportion of their output on the spot and participating in general trade, and those making for the open market are disposing of their production. Continental trade is very dull, with small shipments now and again. Sales are taking place from stocks.

Iron Ore.

The demand for iron ore is largely on local account, but better grades are finding a sale on general account. At most of the mines quite large stocks of iron are held. Importations of foreign ore are quiet.

Steel.

In the steel trade there is a fair amount of industrial activity. Rails are the chief output and fair orders are held, but new business is not plentiful, either on home or overseas account. There is a steady demand for hoops and steel strips for both home and overseas. Castings are quiet.

SHEFFIELD.

(From our own Correspondent.)

A Quiet Start.

THE start of the New Year has been quiet in most departments of the steel trade, at any rate on the heavy side. At most of the large works the holiday was prolonged, and the resumption of operations has been gradual. There is a good deal of optimism with regard to the future, but the improvement in the steel trade has not yet reached the heavy departments. Steel consumers are still displaying no tendency to book forward contracts, and perhaps this is not to be wondered at, for cautious buying has been the rule so long that it has become a habit, and a sudden change is not to be expected. The number of open-hearth furnaces in commission is unchanged, and most of the business coming forward is for immediate requirements only. Neither is any improvement to be noted in the heavy manufacturing departments. While there is a good deal of work on hand in connection with hollow-forged drums and other heavy forgings, the call for shipbuildng steel remains very poor, and the plants devoted to the production of railway supplies are not employed to more than about one-third of their capacity.

The Lighter Side.

The automobile trade continues to be a good customer for Sheffield products, and, while its orders are not up to the best levels, they provide a large amount of work in the production of stampings, forgings, pressings, and special steel for the parts subjected to severe wear and tear. The stainless steel department is also in a healthy state, and there is a good demand for heat-resisting and corrosion-resisting materials. Several other branches of a lighter character are doing very well. One of these is steel strip, either hot or cold-rolled. This section has been very busy for some time, and well maintains its position. It is turning out great quantities of material for safety razor blades, box strapping, and a variety of other purposes. There is also a good demand for best wire. This side of the light steel trade is being developed by Samuel Fox and Co., Ltd., of Stocksbridge (a branch of the United Steel Companies), which is undertaking the manufacture of shoe and staylace tags, and similar products, which have hitherto been imported from the Continent. The magnet trade is enjoying great activity. The progress of wireless affords a field for the outlet of great and ever-increasing quantities of permanent magnets. Seven or eight local firms are doing well in the trade, which consumes a considerable amount of high-grade alloy steel. It is pleasing to hear that, after a long period of dullness, the trade in special steels, both crucible and electric, is improving. The increasing use of the tipped tool reduces the quantity of the best grades of steel required in engineering work, but, nevertheless, makers of these materials report that business is steadily increasing. Several of the hand tool sections are well employed, and are believed to have good prospects.

The "Canadian Corridor."

Some interesting remarks in connection with Colonial trade have been made by Mr. T. Nightingale, managing director of Sheffield Steel Products, Ltd., in dealing with the questions of "Empire content" and the damaging situation which has come to be known as the "Canadian corridor." He referred to efforts which were being made to secure an alteration of the conditions which had permitted the "Canadian corridor" to damage British trade, and, quite definitely, Sheffield trade. "It is obviously commercially immoral," he said, "to allow an article, the material from which it is made being of American origin, with, say, nine-tenths labour put in by United States workmen, to be shipped into Canada, have that last remaining tenth of the essential labour added, and then be capable of being described as of British manufacture, such an article escaping the handicaps of our own products which enter Canada from this side, and enjoying the preferential duties provided in our other Colonies for British-manufactured goods."

A Useless Datum Line.

Mr. Nightingale went on to say that a 50 per cent. datum line for "Empire content" had been agreed upon by the Cabinet. Many of them felt that a 50 per cent. datum line would be utterly useless to the majority of their industries, and they had hotly resisted the acceptance of such a datum line. He had made representations on Sheffield's behalf, and as a result an assurance had been received from the Board of Trade that where evidence could be produced, in cases where 50 per cent. was an insufficient percentage to afford adequate protection against the "Canadian corridor" and other such situations, then supplementary lists, giving higher or lower contents as might be found necessary, would be issued rapidly for the protection of the trades concerned.

An Ottawa Complaint.

Mr. Nightingale stated that in spite of Ottawa the Canadian Government had not removed the special duties they imposed on British goods. At Ottawa, he said, it was understood that this duty would be removed at a very early date, but as yet it stood, and in point of fact they were told that arrangements had been definitely made for it to continue, at any rate for some months to come. This was one of the problems that only business men, by their continued pressure, could help to solve.

Cheaper Electricity for Works.

Sheffield Corporation has just made a useful concession in the price of electric light supplied to works. Power is supplied at the rate of 1d. per unit, but light is 4d. per unit. Hitherto, users of power have been charged 1d. per unit for light up to 5 per cent. of the amount taken for power in works operating during the day only, and up to 20 per cent. in works operating day and night. Now, there is to be a general allowance of 20 per cent. at the 1d. rate. This will enable manufacturers to improve the lighting of their works considerably at little cost. The concession represents about £6000 a year on present lighting bills.

Trade with Scandinavia.

Following up the recent visit of a steel delegation to Scandinavia, headed by Mr. F. C. Fairholme, of Sheffield, the Council of the Sheffield Chamber of Commerce has decided to form a special trade section, consisting of those firms in the city which are interested in trade with Norway, Sweden, and Denmark.

Iron and Steel Institute.

Sheffield is to have the pleasure of entertaining the Iron and Steel Institute on the occasion of its Autumn Meeting this year. The principal firms engaged in the steel industry of the city have united in supporting a very cordial invitation to the Institute, and it has been settled that the meeting shall take place from September 13th to 15th, under the presidency of Mr. W. R. Lysaght, C.B.E., chairman and managing director of John Lysaght, Ltd. The Lord Mayor and Master Cutler are giving their support, and a strong organisation committee has been formed. The last occasion on which the Institute held its autumn general meeting in Sheffield was in 1905, when Sir Robert Hadfield was President.

Contract for Oil Purifiers.

Complete oil purifying equipment for twenty-two stations of the Central Electricity Board's "grid" in North-West England, and also for three stations in Norfolk, is being supplied and installed by British Separators, Ltd., of York, a branch of the Vickers firm. Some of the equipment has already been installed at Barton sub-station, Manchester, and Great Yarmouth sub-station.

NORTH OF ENGLAND.

(From our own Correspondent.)

Tariff Benefit to Tees Trade.

THE marked effect of the import duties on foreign iron and steel is reflected in the statistics of imports to the Teesside district issued this week by the Tees Conservancy Commissioners. These show that in December only 656 tons of iron and steel were imported, as compared with 14,453 tons in December, 1931, and 7059 tons in December, 1913. Not a single ton of crude sheet bars, billets, blooms, &c., was imported during the past month.

Cleveland Iron Trade.

Business is now broadening out on very encouraging lines in the Cleveland pig iron trade, and the outlook is distinctly more hopeful. Stocks are materially augmented during the holidays, but they are no larger than ironmasters consider advisable to carry for ordinary trading, and may soon be exhausted if output is not increased. The needs of producers' own consuming works are becoming heavier, and it is expected that other home needs will result in increased buying. A satisfactory feature of the market is that buyers are showing a disposition to discuss forward contracts. The ironmasters continue to offer special terms to Scottish and foreign buyers, but home consumers can only buy at the fixed offered figures. No. 1 Cleveland foundry iron is 61s.; No. 3 G.M.B., 58s. 6d.; No. 4 foundry, 57s. 6d., and No. 4 forge, 57s.

Hematite Pig Iron.

The unsatisfactory statistical state of the East Coast hematite branch keeps values at a comparatively low level. Demand is improving, however, both for home use and shipment abroad, though Continental competition for overseas trade continues keen. Merchants still possess a good deal of iron and are slightly underselling producers. The latter ask 59s. for mixed numbers and 59s. 6d. for No. 1 quality.

Ironmaking Materials.

Business in foreign ore is virtually at a standstill. The nominal price of Rubio of 50 per cent. quality is 15s. 6d. c.i.f. Tees. Blast-furnace coke quotations are upheld on the basis of good medium qualities at 16s. 3d., delivered to North-East Coast works, but market transactions are few, consumers having considerable supplies of their own makes.

Manufactured Iron and Steel.

In several branches of the semi-finished and finished iron and steel trade some enlargement of tonnage output is promised, but business is on a rather quieter scale. The fall in Continental prices has opened up the possibility of further cheap imports, but it does not appear that any substantial business has been placed abroad. The upward movement in prices of iron and steel scrap continues to gain strength. Buyers are prominent, and there is rather a severe shortage of certain descriptions. Among the principal market quotations are: Borings, 23s.; steel turnings, 32s. 6d.; light cast iron, 37s.; heavy cast iron, 39s. to 40s.; machinery metal, 42s. 6d.; and heavy steel, 37s. 6d. to 40s.

The Coal Trade.

Generally speaking, the Northern coal trade position is little altered. There is, however, a quieter tone in Northumberland, though loading turns are full for the ensuing week. Individual circumstances of collieries in Durham vary a good deal. Some pits would welcome more trade and others have large orders to fulfil—so much so, that they contemplate opening out idle seams. Prices are steady, but are not likely to go any higher at present, as to a considerable extent buyers have covered their immediate requirements. Even when there is pressure for supplies it is not easy to secure higher prices for export, as this is a very competitive business. Consumers abroad have numerous alternative fuels to choose from, offered usually at lower prices than are asked for British coal and coke. For early loadings best Northumberland steams are quoted at 14s. 6d., and Tyne primes at 13s. 6d. to 13s. 9d. Seconds are about 12s. 6d. to 13s. Smalls are quoting still around 8s. to 9s., as many sorts are not obtainable for this month. Durham steams are firm at 16s. for large, and 11s. to 12s. for other qualities. The coking market is quiet, but orders are sufficient to cover the output and prices are well maintained at 12s. 6d. to 13s. 3d. Durham gas coals are in fair inquiry, and the position generally is good. Best qualities are unchanged at 14s. 6d., and seconds at 13s. to 13s. 6d. Wear specials are unaltered at 15s. The market for bunker coal is good and recent figures are still obtainable. Best sorts are commanding up to 15s. and the seconds 13s. 3d. to 13s. 6d. Gas coke is very firm and short of supply. Best qualities are almost unobtainable for January, and are firmly held at 18s. 6d. Patent foundry makes are unaltered at 15s. 6d. to 16s. 6d., and beehive brands are 22s. to 24s.

Blast-furnacemen's Wages.

The quarterly ascertainment governing the wages of blast-furnacemen at North-East Coast ironworks brought no change. It is certified that the average net selling price of No. 3 Cleveland pig iron for October, November, and December is 50s. 10·95d. per ton, which compares with 51s. 10¼d. per ton in the previous quarter. In accordance with the sliding scale arrangement, blast-furnacemen's wages will remain unaltered for the first quarter of this year, i.e., neither base rates, nor bonus, will carry any percentage for the current quarter.

New Ship to be Built.

It is understood that Swan, Hunter and Wigham Richardson, Ltd., propose to build on their own account at Wallsend a large motor cargo vessel in order to provide employment for some of their staff and workmen. The firm has already during the severe depression built two vessels under similar conditions. The only other work which the firm has in hand is the two British destroyers ordered about two months ago, and which are to be built at the Wallsend yard.

Wage Cut not Enforced.

The wages of Cleveland ironstone miners will continue unchanged for the ensuing three months. This decision was the outcome of a conference between the Cleveland mineowners and men's representatives this week. On the ascertained price of pig iron for the past quarter, the employers were entitled to reduce wages, but they once more undertook to leave them unaltered for a further three months. At the same time the owners made it clear that they were unable to continue the concessions indefinitely. For two years they have foregone reductions to which they have been entitled under the ordinary operation of the sliding scale. Unless there was some improvement in trade and prices very soon, the owners intimated that they would be reluctantly compelled to ask the men to accept a reduction in wages.

SCOTLAND.

(From our own Correspondent.)

Nominal Markets.

In most markets holiday influences are still apparent, and in all probability another week will pass before conditions are more normal. A fair restart was made at the collieries, but a large proportion will not be in action until about the end of this week. Similarly, in the iron trade the restart has been delayed, and the works engaged in the production of heavy steel will remain idle until January 16th. The outlook on the whole shows little change, but there is a greater feeling of confidence that the corner has been turned, and that a gradual improvement in industry will be noticeable during the coming months.

Shipbuilding.

In the opinion of some directly connected with the shipbuilding industry, prospects are decidedly better. It would appear that recent inquiries have more definite purpose behind them, and it is confidently anticipated that fresh contracts will be announced in the near future for tramp steamers of modern design. Should such prove to be the case, the industry will gain considerable encouragement as orders for tramps have been extremely meagre for some time past.

Steel.

With the market affected by the holidays, business has been more or less at a standstill, and very little in the way of fresh orders has been booked, although the general inquiry is said to be better and indicates a wider interest in British products.

Iron.

In this trade foreign competition has been eliminated meantime, but regular consignments continue to arrive from India and occasional lots from England. At present there seems little prospect of increasing the output beyond the two furnaces in blast. There has been a little more business in scrap materials of late and prices are a shade firmer at 37s. 6d. for heavy steel and 47s. 6d. per ton for cast iron machinery.

Coal Shipments.

The total shipments from Scottish ports during the year 1932 amounted to 12,078,747 tons, which shows an increase of 1,178,611 tons compared with 1931.

Coal.

The coal market has not yet settled down since the holidays and the turnover continues on restricted lines, more especially for export. Most qualities of fuel in all districts are fairly well sold for the first half of this month and prices are firmly maintained, the only exception being certain sizes of nuts, which are now more freely offered. Shipments during the past week amounted to 117,606 tons, compared with 234,652 in the preceding week and 160,850 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

The Coal Trade.

In one sense the New Year opened very favourably for the coal trade, inasmuch as shipments at the ports under the control of the Great Western Railway Company came to 378,200 tons, as compared with 313,696 tons for the corresponding period of last year, while as was to be expected the total marked an advance upon the preceding week, when holidays affected adversely productive and loading operations. Furthermore, the tonnage position at the docks last week was an improvement upon the returns for some time previously, while this week opened with the number of idle loading appliances amounting to eighteen, with seven steamers waiting to berth. These figures are better than those recorded for months past. Barry docks having no tips idle but three steamers waiting. The fact is that just before the recent holidays chartering was quite active, and this, combined with tonnage arriving which had been delayed by bad weather, has resulted in quite a fair amount of loading pressure. This, however, is the favourable side of affairs, as it has to be admitted that the current inquiry for fresh supplies is very meagre indeed. This applies to all directions of trade. There appears to be a decided lull in operations, and certainly inquries go to show that stocks abroad are on the heavy side, as a consequence of the mild weather prevailing and the slowing up of consumption. Doubtless in a few weeks there will be a revival in the foreign demand, but orders at present held are negligible. As regards contract business, this also is on the quiet side, though there is one inquiry on the market, namely, from the Andaluces Railway of Spain for 21,000 tons of large coals for delivery from February to September next at Malaga, Algeciras, Cadiz, and Almeria. Tenders have to go in at the end of this week.

Coal Loading Hours.

The question of loading hours at South Wales docks has cropped up during the past week or so by reason of the fact that the conditions in this area compare unfavourably with those in other districts, which enable steamers to load and avoid detention over the week-ends. The fact is that at South Wales ports the loading of vessels terminates at noon on Saturdays, except in the case of vessels finishing, in which event work is carried on for an extra hour to 1 p.m. It is, however, contended that working hours should be more elastic, and that in cases, where required, loading operations should be continued throughout the Saturday afternoons and evenings, if necessary, so that steamers can be got away instead of having to wait until Monday morning for a few hundred tons of coal. This district is certainly at a disadvantage compared with others in this respect, and it means loss of coal orders, as instances have been known in which steamers have not been sent to this district to bunker because of the fact that shippers could not guarantee to load the vessels on the Friday and Saturday. Furthermore, in these hard times for shipowners, despatch is everything to them. Efforts have been made for a long time past to get the tippers and trimmers to agree to work extra time, but so far they have failed. According to the chief docks manager of the Great Western Railway Company, which in recent years has considerably improved the loading appliances at its various docks, the company intends to continue its efforts to get some extension of working time, and not to let the matter drop.

Coal versus Oil.

Evidence of the alertness of the coal interests to further the consumption of coal, as against oil, has been forthcoming during the past week or so Scarcely had the Great Western Railway disclosed the fact that in its 1933 programme for new constructions it had included a new oil fuel steamer for service on the Fishguard route to Ireland, than the South Wales Coalowners' Association and the Back-to-Coal Movement were quick to take up the matter, and as the result of representations it is now announced that the Secretary of the South Wales Coalowners' Association has received a reply from the company which has been sent out to the members of that body. It has since been officially announced that the Great Western Railway Company has sympathetically considered the representations made by the coalowners and the placing of the work for the proposed new oil fuel steamer has been postponed pending further consideration.

Miscellaneous Items.

When it became known that the British (Guest, Keen, Baldwins) Iron and Steel Company, Ltd., had received an order for steel sleepers from the Great Western Railway Company, the Mayor of Merthyr took steps to secure, if possible, that the work should be carried out at the Dowlais-Merthyr Works, which were closed two years ago, causing much unemployment in that district. Now it is disclosed by the British (G.K.B.) Iron and Steel Company in a letter to the Mayor of Merthyr that the greater part of the steel bars have already been manufactured, and are lying at Dowlais awaiting pressing, which operation will employ 160 men for six weeks. On Thursday of last week about 400 men employed in the mills department of the Elba Tin-plate Works, King's Dock, Swansea, ceased work as a protest against the dismissal of two workmen. The stoppage was quite unofficial. As the result of negotiations, it was not of long duration, a settlement being arrived at on Saturday, enabling a resumption of work to take place on Monday. As the result of a semi-official announcement it was generally understood that agreement had been reached between the employers in the ship-repairing industry and the representatives of all the unions, so that revised working conditions in the ship-repairing yards in this area would come into force as from the beginning of this year. It appears, however, that complete agreement was not come to with the Amalgamated Engineers' Union, as a ballot of the members turned down the new conditions. Since then negotiations have been continued, as the result of which it is confidently expected that the revised working rules will come into operation at the beginning of February. For the first time for three years steel ingots were produced at the Cwmfelin Steel Works, Swansea, of Richard Thomas and Co., Ltd., on Wednesday of last week.

Laid-up Tonnage.

There was an improvement in the position as regards tonnage laid up at South Wales ports on the 1st inst., as compared with the situation on October 1st last. The returns show that at the beginning of this year there were fifty-three British steamers of 97,790 tons net register and four foreign-owned steamers of 7222 tons net register on the laid-up list, whereas on October 1st the number of vessels was eighty-nine British of 179,879 tons net register and one foreign-owned steamer of 2342 tons net register.

Current Business.

The tone of the steam coal market is quiet, though sized coals maintain their firmness. The inquiry generally for the time being is slow, but it is fully expected that towards the end of the month the conditions will improve. Coke is a steady section, while patent fuel, owing to the increase in the cost of pitch, has been advanced, Crown fuel now being quoted at 22s. Pitwood is easy at 21s. 6d. to 22s. Formerly the bulk of the pitwood imported into South Wales came from France, but supplies from this direction have fallen off substantially, owing to the fact that French pitwood owners insisted on relatively high prices with payment on a gold basis. Now reports have been received from France that owners of timber in the Landes district in the southern part of the Bay of Biscay are seeking to operate on the lines of barter arrangements.

CALENDARS, DIARIES, &c.

WILLIAM BRYDE, 24, Chapel-street, Liverpool.—Pennsylvania Railroad wall calendar.

"CHEMICAL TRADE JOURNAL AND CHEMICAL ENGINEER."—Wall calendar.

CROFTS (ENGINEERS), Ltd., Bradford, Yorks.—Wall calendar.

DEXINE, Ltd., Stratford, E.15.—Diary.

FLOWERDEW AND CO., Ltd., 227–228, Strand, W.C.2.—Wall calendar.

HILDICK AND HILDICK, Walsall.—Wall calendar.

IMPERIAL AIRWAYS.—Greeting card.

JONES, YARRELL AND CO., 143, Fetter-lane, E.C.4.—Wall calendar.

LANCASHIRE UNITED TRANSPORT AND POWER COMPANY, Ltd.—Wall calendar.

MESSENT AND BOND, 1, Clerkenwell-green, E.C.1.—Wall calendars.

JAMES NEILL AND CO. (SHEFFIELD), Ltd., Sheffield.—Diary.

RUSTON-BUCYRUS, Ltd., Lincoln.—Wall calendar.

S. S. STOTT AND CO., Haslingden.—Wall calendar.

WELIN MACLACHLAN DAVITS, Ltd., 525, Grand Buildings, Trafalgar-square, W.C.2.—Refill for desk frame.

F. WIGGLESWORTH AND CO., Ltd., Shipley, Yorks.—Diary.

W. H. WILLCOX AND CO., Ltd., 38, Southwark-street, S.E.1.—Wall calendar.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

FULLERTON, HODGART AND BARCLAY, Ltd., of Paisley, have appointed E. John Wheen and Co., Ltd., 90, Cannon-street, London, E.C.4, to be their representatives in the South of England.

MR. G. S. PREST terminated his appointment as London manager of C. A. Parsons and Co., Ltd., at the end of the year. Mr. A. A. W. Wynne and Mr. P. E. Newnam have been appointed district managers, whilst Mr. A. Q. Carnegie will continue his office as resident director of the company at 56, Victoria-street, S.W.1.

H. AND T. DANKS (NETHERTON), Ltd., Netherton, Dudley, announce that in view of their increasing business, and new developments, they have appointed as general manager, as from January 2nd, 1933, Mr. R. G. Reid, of Stockton-on-Tees, formerly works manager and chief engineer to Ashmore, Benson, Pease and Co., Ltd.

THE BRITISH TRANE COMPANY, Ltd., 26, Rosebery-avenue, E.C.1, has appointed Mr. J. E. Dunlop, 50, Wellington-street, Glasgow, as selling agent for the Scottish area. Messrs. F. Kirkup and Co., 90, Pilgrim-street, Newcastle-on-Tyne, are acting in a similar capacity for the counties of Durham, Cumberland, Northumberland, and Westmorland.

THE representation of Bolinder oil engines and woodworking machinery, which has in the past been in the hands of James Pollock, Sons and Co., Ltd., 3, Lloyds-avenue, London, E.C.3, is now being dealt with direct by the Bolinders Company, Ltd., which has been registered at Somerset House for dealing with the British business. For the time being the Bolinders Company, Ltd., has taken over Messrs. Pollock's fourth floor offices at 3, Lloyds-avenue, London, E.C.3.

MR. WILLIAM JOHN RICKETS, A.M.I.E.E., formerly technical director of Alfred Graham and Co., Ltd., manufacturers of marine telephones and electrical signalling equipment, and of Graham Amplion, Ltd., electrical and radio engineers, has now opened an office at Fearon House, 39, Holborn-viaduct, E.C.1, as a "Consulting Inventor." His principal activity will consist in solving new and difficult technical problems, requiring invention, for a number of manufacturer.

CONTRACTS.

DORMAN, LONG AND CO., Ltd., 55, Broadway, S.W. 1, inform us that they have secured a contract for the supply and erection of the steelwork for a new cinema at Worthing.

BRAITHWAITE AND CO., ENGINEERS, Ltd., of Westminster, West Bromwich, and Newport, have received from the Swansea Borough Council an order for the supply and erection of over 6000 tons of structural steel work for its new large power station.

THE INSTITUTE OF METALS.—The President of the Société des Ingénieurs Civils de France, Monsieur Albert Portevin, has accepted the invitation of the Institute of Metals Council to give the next annual May lecture before the Institute. Monsieur Portevin has chosen as the title of his discourse "Quenching and Tempering Phenomena in Alloys." The lecture will be delivered on Wednesday, May 10th, at the Institution of Mechanical Engineers, Storey's-gate, Westminster, at 8 p.m. The Institute, which this year celebrates the twenty-fifth anniversary of its foundation, will hold its annual general meeting in London on March 8–9th. Upwards of a dozen papers will then be presented for discussion. In the evening of March 8th the annual dinner will be held, under the chairmanship of Sir Henry Fowler.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
(1) Native	15/- to 20/-
(1) Spanish	17/- to 24/-
N.E. COAST—	
Native	18/- to 21/-
Foreign (c.i.f.)	15/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	3 6 0	—
No. 1 Foundry	3 10 0	—
No. 3 Foundry	3 7 6	—
N.E. COAST—		
Hematite Mixed Nos.	2 19 0	2 19 0
No. 1	2 19 6	2 19 6
Cleveland—		
No. 1	3 1 0	3 1 0
Siliceous Iron	3 1 0	3 1 0
No. 3 G.M.B.	2 18 6	2 18 6
No. 4 Foundry	2 17 6	2 17 6
No. 4 Forge	2 17 0	2 17 0
Mottled	2 16 6	2 16 6
White	2 16 6	2 16 6
MIDLANDS—		
(c) Staffs.—	(*Delivered to Station.*)	
All-mine (Cold-blast)	—	—
North Staffs. Forge	3 1 0	—
" " Foundry	3 6 0	—
(c) Northampton—		
Foundry No. 3	3 2 6	—
Forge	2 17 6	—
(c) Derbyshire—		
No. 3 Foundry	3 6 0	—
Forge	3 1 0	—
(3) Lincolnshire—		
No. 3 Foundry	—	—
No. 4 Forge	—	—
Basic	—	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	3 15 6 (*a*) / 4 0 6 (*b*) / 4 5 6 (*c*)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	9 15 0	9 5 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 5 0	—
Common Bars	9 5 0	—
Best Bars	10 5 0	—
Double Best Bars	10 15 0	—
Treble Best Bars	11 5 0	—
LANCS.—		
Crown Bars	9 15 0	—
Best Bars	10 5 0	—
Hoops	12 0 0	—
S. YORKS.—		
Crown Bars	9 15 0	—
Best Bars	10 15 0	—
Hoops	12 0 0	—
MIDLANDS—		
Crown Bars	9 0 0 to 9 15 0	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	8 0 0 to 8 10 0	—
Gas Tube Strip	10 7 6 to 10 10 0	—

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates (Marine)	9 0 0	8 10 0
" " (Land)	—	—
Ship Plates, ¾in. and up	8 15 0	7 15 0
Sections	8 7 6	7 7 6
Steel Sheets, ¼in.	7 15 0	7 15 0
Sheets (Gal. Cor. 24 B.G.)	11 5 0–10 Ton Lots and Upwards Delivered Glasgow Stations.	10 0 0
" (Gal. Cor. 24 B.G.)	For Canada	10 15 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 15 0	7 15 0
Angles	8 7 6	7 7 6
Boiler Plates (Marine)	10 10 0	—
" " (Land)	10 0 0	—
Joists	8 15 0	7 7 6
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	7 2 6	—
Soft Billets	5 10 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	—
Billets	6 10 0 to 9 0 0	—
MANCHESTER—		
Bars (Round)	9 7 6	—
" (Small Round)	6 15 0	—
Hoops (Baling)	10 0 0	9 15 0
" (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
" (Lancs. Boiler)	8 10 0	—
SHEFFIELD—		
Siemens Acid Billets	9 2 6 (basis)	—
Hard Basic	8 2 6 and 8 12 6	—
Intermediate Basic	6 12 6 and 7 2 6	—
Soft Basic	5 15 0	—
Hoops	9 10 0 to 9 15 0	—
Soft Wire Rods	7 10 0	—
MIDLANDS—		
Small Rolled Bars (all British)	7 0 0 to 7 5 0	—
Small Re-rolled Bars	6 15 0 to 6 17 6	—
Billets and Sheet Bars	4 17 6 to 5 7 6	—
Galv. Sheets	11 15 0 to 13 15 0	10 10 0
(2) Staffordshire Hoops	9 10 0	—
(*d*) Angles	8 7 6	—
(*d*) Joists	8 15 0	—
(*d*) Tees	9 7 6	—
(*d*) Bridge and Tank Plates	8 17 6	—
Boiler Plates	8 7 6 to 8 10 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14 f.o.b.	15/9 to 16/3
Block Tin (cash)	146 7 6
" (three months)	146 17 6
Copper (cash)	28 17 6
" (three months)	29 5 0
Spanish Lead (cash)	10 5 0
" " (three months)	10 13 9
Spelter (cash)	14 12 6
" (three months)	14 18 9
MANCHESTER—	
Copper, Best Selected Ingots	33 5 0
" Electrolytic	34 5 0
" Strong Sheets	65 0 0
" Tubes (Basis Price), lb.	0 0 10
Brass Tubes (Basis Price), lb.	0 0 9
" Condenser, lb.	0 0 11½
Lead, English	12 5 0
" Foreign	10 17 6
Spelter	15 0 0
Aluminium (per ton—raw ingot)	£95

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/10½ per lb.	
Ferro Tungsten	1/7½ per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£25 15 0	8/-
" " 6 p.c. to 8 p.c.	£24 10 0	7/6
" " 8 p.c. to 10 p.c.	£22 5 0	7/-
" " Specially Refined		
" " Max. 2 p.c. carbon	£36 10 0	11/-
" " " 1 p.c. carbon	£42 12 0	14/-
" " " 0·70 p.c. carbon	£44 0 0	16/-
" " " carbon free	1/- per lb.	
Metallic Chromium	2/9 per lb.	
Ferro Manganese (per ton)	£10 15 0 for home	
" " "	£9 15 0 for export	
" Silicon, 45 p.c. to 50 p.c.	£13 10 0 scale 5/- per unit	
" " 75 p.c.	£19 10 0 scale 6/- per unit	
" Vanadium	12/6 per lb.	
" Molybdenum	6/3 per lb.	
" Titanium (carbon free)	9d. per lb.	
Nickel (per ton)	£245 0 0	
Ferro Cobalt	7/9 per lb.	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	15/-
" " Ell	16/- to 16/6
" " Splint	16/6 to 17/6
" " Trebles	15/- to 16/-
" " Doubles	12/6 to 13/-
" " Singles	11/6
AYRSHIRE—	
(f.o.b. Ports)—Steam	14/6
" " Jewel	16/6
" " Trebles	15/6 to 16/-
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	13/- to 15/-
Screened Navigation	16/6 to 17/6
Trebles	16/6 to 18/6
Doubles	12/9 to 14/-
Singles	10/9 to 11/-
LOTHIANS—	
(f.o.b. Leith)—Best Steam	13/6 to 14/-
Secondary Steam	13/6
Trebles	15/6 to 16/-
Doubles	12/- to 12/6
Singles	11/3 to 11/9

(8) N.W. COAST— ENGLAND.

Steams	19/- to 23/6
Household	32/6 to 52/6
Coke	18/- to 21/-
NORTHUMBERLAND—	
Best Steams	14/6
Second Steams	12/6 to 12/9
Steam Smalls	8/6
Unscreened	12/6 to 13/-
Household	27/- to 39/-
DURHAM—	
Best Gas	14/6
Second	13/3 to 13/6
Household	25/- to 37/-
Foundry Coke	24/-

SHEFFIELD	Inland.
Best Hand-picked Branch	27/- to 28/-
South Yorkshire Best	23/- to 24/-
South Yorkshire Seconds	18/- to 21/-
Derbyshire Best House	22/- to 23/6
Derbyshire Best Brights	18/- to 20/-
Screened Seconds	17/6 to 19/-
Kitchen Coal	16/6 to 17/6
Best Screened Nuts	17/- to 18/6
Small Screened Nuts	16/- to 16/6
Yorkshire Hards	17/- to 18/-
Derbyshire Hards	17/- to 18/-
Rough Slacks	8/6 to 9/6
Nutty Slacks	7/- to 8/6
Blast-furnace Coke (Inland)	10/- on rail at ovens
Furnace and Foundry Coke (Export), f.o.b.,	14/6 to 15/6

(9) SOUTH WALES.

CARDIFF—	
Steam Coals :	
Best Smokeless Large	19/6 to 19/9
Second Smokeless Large	18/9 to 19/6
Best Dry Large	19/- to 19/6
Ordinary Dry Large	17/9 to 18/3
Best Black Vein Large	18/3 to 18/6
Western Valley Large	17/9 to 18/-
Best Eastern Valley Large	17/7½ to 17/9
Ordinary Eastern Valley Large	17/3 to 17/6
Best Steam Smalls	13/- to 13/6
Ordinary Smalls	11/- to 13/-
Washed Nuts	20/- to 32/-
No. 3 Rhondda Large	19/6 to 19/9
" " Smalls	15/- to 16/-
No. 2 " Large	17/- to 17/3
" " Through	15/6 to 16/-
" " Smalls	14/- to 14/3
Foundry Coke (Export)	22/6 to 36/6
Furnace Coke (Export)	17/- to 18/-
Patent Fuel	22/-
Pitwood (ex ship)	21/6 to 22/-
SWANSEA—	
Anthracite Coals :	
Best Big Vein Large	36/- to 38/6
Seconds	27/- to 34/-
Red Vein	22/- to 26/6
Machine-made Cobbles	37/6 to 48/6
Nuts	36/6 to 48/6
Beans	28/6 to 32/6
Peas	19/6 to 21/-
Breaker Duff	8/6 to 9/6
Rubbly Culm	8/6 to 9/-
Steam Coals :	
Large	20/- to 20/6
Seconds	18/- to 20/-
Smalls	11/6 to 13/-
Cargo Through	16/- to 17/6

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate : Joists (minimum), 22/6 ; Ordinary Ship, Bridge, and Tank Plates and Sections, 15/-, if home consumers confine purchases from associated British Steel Makers. (*e*) Delivered Black Country Stations.

French Engineering Notes.

(From our own Correspondent in Paris.)

German Machinery Imports.

THE commercial arrangement entered into between France and Germany in 1927 had the effect, of increasing considerably the volume of imports from Germany and in widening the balance of trade to the detriment of this country. In 1929 Germany supplied France with 59 per cent. of her total imports of machinery. In the following year it rose to 64 per cent., and was still 63 per cent. in 1931. For some mechanical productions the German share of the imports into France advanced to as much as 80 and 90 per cent. A large increase of machinery imports at a time when the French engineering industries were feeling the effects of the world crisis, and when the French Government was anxious to remove treaty obligations that prevented it from embarking upon a new policy of commercial exchanges, made it necessary for further negotiations to be undertaken with Germany with a view to modifying the terms of the existing treaty agreement. The results so far obtained are interesting because they show what is likely to be done in the case of treaties with other countries. The French idea was to suppress the most-favoured-nation-treatment clause and to apply intermediate tariffs between the maximum and the minimum, so that they would be free to deal independently with each country without reference to treaty obligations elsewhere. They have not been able to do what they desired with Germany, which would not forego the most-favoured-nation treatment, but agreed to certain limitations which exclude from the clause compensating taxes against countries with depreciated currencies, frontier commercial relations, and other matters that do not affect commercial exchanges as a whole. The German refusal to abandon most-favoured-nation treatment precludes the French from manipulating their tariffs in a discriminating manner when dealing with different countries. All that could be done was to authorise each country to raise particular duties by giving two weeks' notice to the other, which would have the option of raising similarly the duties on other goods, not as a measure of reprisal, but as an adjustment in the exchanges of different goods. The French could, of course, have secured the liberty they hoped to obtain by denouncing the existing treaty of commerce, but that would have caused serious trouble, which, in present circumstances, must be avoided at all costs.

The Forty-hours' Week.

The preliminary conference just begun at Geneva to discuss the programme of the International Labour Bureau for a forty-hours' working week was heralded by a vigorous campaign on the part of the ultra Socialist Confédération Générale du Travail in support of the shorter week without wage reductions. Labour expects to have the Socialist Government on its side, and employers have, therefore, taken a definite stand that can leave no doubt as to what the ultimate issue will be. At a meeting in Paris last week, representatives of 3000 industrial organisations, whose members employ 7,000.000 hands, declared that such a reform would have "a first and inevitable result of increasing production costs and raising selling prices, whereby all classes of consumers would suffer; it would reduce the export trade, increase private and public budget deficits and cause a further contraction of national wealth." Even if the forty-hours' week were accepted by all other countries as a means of decreasing unemployment, it would still be inacceptable in this country, where the supply of labour is normally below the demand, and if there is unemployment in the industrial centres, it is because the development of industry has continued at the expense of agriculture, which is obliged to import labour, and in times of activity a considerable number of workers have to be imported for industry as well. The short week is, therefore, no remedy for unemployment, since the quarter of a million hands officially declared to be out of work would be quickly absorbed by a trade recovery, and in times of activity the short week would necessitate an enormous influx of foreign labour. In Belgium the opposition to the I.L.B. proposal is equally strong. The Comité Central Industriel in that country has explained to the Government the reasons why the forty-hours' week would be an "incalculable danger," and it states that even if all European countries accepted the proposal it would still constitute a danger in face of the industrial development of Asiatic countries, while it is doubtful whether the United States would fall in with the scheme.

Paris Tramways.

About a year ago the General Council of the Seine decided that all the tramways in Paris should be suppressed within a period of five years. The work has proceeded slowly on account of the difficulties experienced by the Société des Transports en Commun in obtaining a sufficient number of omnibuses to take over the services of the condemned tramways, and in order that the substitution shall be effected in the time allotted the General Council last week voted a sum of 53 million francs for the removal of existing tramlines and the provision of 300 new omnibuses. A similar sum will be voted annually until the programme is completed. When the tramways have disappeared in Paris it is proposed to continue the substitution in the suburbs. The tramways are condemned as being a cause of traffic congestion.

Level Crossings.

It has been said that the time lost at railway level crossings would, if represented in money value, pay for their suppression. There are 40,000 of them in this country, and of this number 6000 traverse national roads. It is now felt that some great effort must be made to do away with them, for which purpose a plan has been prepared for the systematic removal of level crossings at a cost of 202 million francs. No one knows yet where that money will come from, but it is hoped to derive some of it from the funds to be provided for the national programme of public works.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

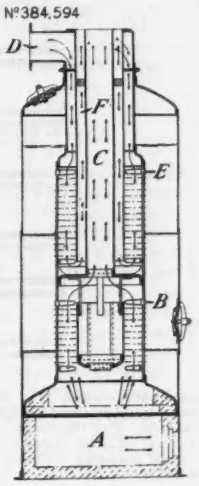
The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM GENERATORS.

384,594. June 30th, 1932.—EXHAUST GAS BOILERS, The Clarkson Thimble Tube Boiler Company, Ltd., 613, Australia House, Strand, London, W.C.2; and W. J. Niven.

This boiler is intended to be heated with the exhaust gases of an internal combustion engine, but can also be fired directly with oil fuel. The oil fuel is burned in the combustion chamber A and the products of combustion pass up between the thimble tubes B to escape through the central chimney C. The exhaust gases are delivered to the boiler at D and, after passing downward through the nest of thimble tubes E, escape by the annular chimney F. It is claimed that all parts of the boiler are readily accessible for inspection.—*December 8th*, 1932.

Nº 384,594

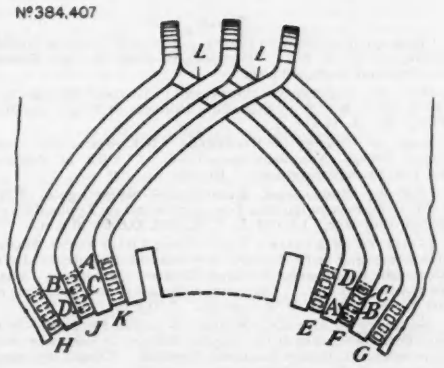


DYNAMOS AND MOTORS.

384,407. October 29th, 1931.—DYNAMO-ELECTRIC MACHINES FOR HIGH POTENTIAL, Siemens-Schuckertwerke Aktiengesellschaft, of Berlin-Siemensstadt, Germany.

This invention relates to polyphase dynamo-electrical machines for high potential in the stator windings of which several conductors are situated one above the other in one slot. With such machines it is a well-known practice to connect the conductors so that in each phase the conductors in each layer are connected in series. According to the invention, the bundles of conductors A B C D are laid in the slots E F G respectively

Nº 384,407

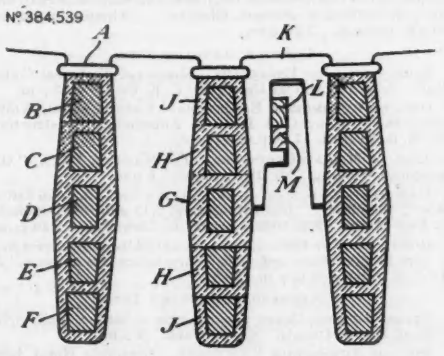


the conductors of the corresponding ends of the bundles being placed in the slots H J K in the inverse order of succession. For this purpose each bundle is correspondingly twisted at the winding head and not merely simply bent over. The result of this arrangement is that at the points of intersection L of the bundles of conductors, conductors of similar potential lie adjacent to one another. The arrangement of the conductors is such that the adjacent conductors of similar potential are the conductors of the lowest potential in their bundles, and the conductors of high potential lie as far apart as possible.—*December 8th*, 1932.

384,539. April 26th, 1932.—DYNAMO-ELECTRIC MACHINES, Siemens-Schuckertwerke Aktiengesellschaft, of Berlin-Siemensstadt, Germany.

In the case of dynamo-electric machines, especially with very high working pressure (up to 40 kV and above), the insulation of the conductors presents considerable difficulties, as relatively thick layers of insulating material must be employed, which

Nº 384,539

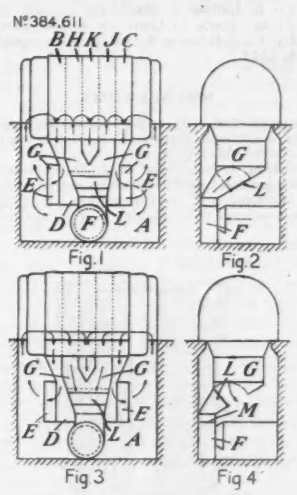


results in increasing the size of the slots and thereby in less complete utilisation of the material of the machines. The present invention discloses an arrangement of conductors for the winding of such machines and enables the winding space to be kept very small. The iron of the stator is provided with double wedge-shaped slots A. Five conductors B to F are arranged together in each slot. The highest voltage is associated with the conductors D in relation to the iron of the machine, the next lower voltage to the conductors C and E and the lowest voltage to the conductors B and F. The insulating can be effected in a simple manner, in that the centre conductor is surrounded with a closed sheath G, whilst U-shaped sheaths H and J are placed over the other conductors. In order to permit of a simple introduction of the winding into the machine, every tooth formed between the individual slots is split in the centre and provided with a detachable head. With this arrangement the head K of the tooth can easily be pushed in between two adjacent slots and then be pressed home by means of wedges L and M. Owing to the symmetrical arrangement by which the conductors of highest voltage are always situated in the centre, dangerous field stresses are avoided, even at the crossings in the winding heads.—*December 8th*, 1932.

384,611. July 21st, 1932.—THE VENTILATION OF DYNAMO-ELECTRIC MACHINES, The English Electric Company, Ltd., of Queen's House, 28, Kingsway, W.C.2; and Frederick Albin Youngmark, of Siemens Works, Stafford.

The primary object of the invention is to provide simple means for by-passing the single external fan of a generator when it is not running and when the ventilation is provided entirely by the fans on the shaft, as when running below maximum load. Air is drawn from the intake chamber A into each end of the machine casing by internal fans mounted on the rotor shaft and after circulating round the annular channels B and C is discharged into the inner chamber D, from where it passes through the coolers E back to the outer chamber A. If the single external independently driven fan F is also running, air from the chamber A is forced through the bifurcated trunkway G to the annular channels H and J in the machine casing. Since the annular

Nº 384,611



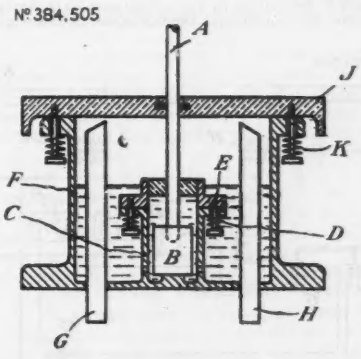
channels B C H J and K communicate with one another, air from the channels H and J may reach the exhaust chamber D by way of either the middle channel K or the end channels H and C. The path of the air propelled by each fan is indicated by the arrows. When the fan F is stopped the hinged door L in the trunkway G below the junction of the two branches should be swung from the position in which it is shown in Fig. 2 to that shown in Fig. 4. In the latter position it uncovers openings through which air can pass from the trunk G to the inner chamber D and it also covers up the mouth of the outlet M from the fan F. As indicated by the arrows in Fig. 3, air is drawn from the chamber A into each end of the machine casing, and after circulating round the channels B C H J and K escapes—either directly or through the branches of the trunkway G—to the inner chamber D, whence it returns, by way of the coolers E, to the chamber A.—*December 8th*, 1932.

SWITCHGEAR.

384,505. March 10th, 1932.—EXPANSION SWITCHES, Siemens-Schuckertwerke Aktiengesellschaft, of Berlin-Siemensstadt, Germany.

The operation of the switch described in this specification is as follows:—When the switch rod A moves away from the part B the arc causes fluid to vaporise in the vapour chamber C, and if the pressure of the vapour reaches that of the springs D the chamber opens, the upper part E moving upwards and thereby compressing springs D. The vapour passes under high pressure at high speed into the condensation chamber F and forces some liquid upwards. Of this only a small quantity is expelled through tubes G and H; most of it remains in the condensation chamber. Owing to the relatively large vapour space in the condensation chamber and its connection with the outer

Nº 384,505

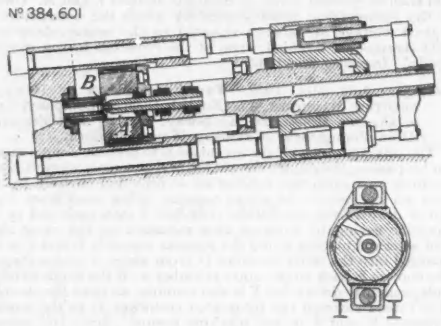


air through the tubes G and H, under normal conditions the back pressure which is produced in the condensation chamber does not exceed reasonable limits, so that the quantity of outflowing vapour necessary to produce the required rate of expansion from vapour chamber C is produced during the occurrence of several zero current values. The arc will therefore be extinguished during one of the moments of zero current. On the other hand, for heavy switch duty the cover J comes into operation. When the back pressure exceeds a certain value the cover J rises against the pressure of springs K, causing a large additional outflow opening between the flange and cover. A second powerful expansion then occurs, which causes the arc to be extinguished during its instant of zero current.—*December 8th*, 1932.

MACHINE TOOLS AND SHOP APPLIANCES.

384,601. July 7th, 1932.—LEAD CABLE PRESSES, Hydraulik Gesellschaft mit beschränkter Haftung, 72, Mülheimerstrasse, Duisburg, Germany; and O. Schlenstedt, 64, Hundsbuschstrasse, Mülheim-Ruhr-Speldorf, Germany.

In this press for covering cables with a sheath of lead the lead chamber A is pushed forward over the chuck which holds the

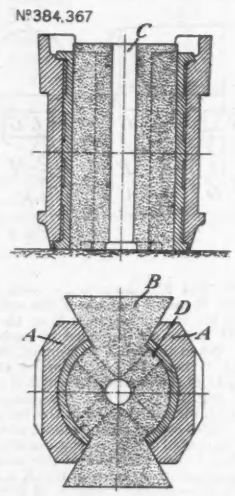


die B by the ram C, while the hollow mandrel is held stationary. The ram also is hollow to allow the passage of the cable. Arrangements are made to keep the several parts truly concentric, so that the coating on the cable will be equal all round.—*December 8th*, 1932.

METALLURGY.

384,367. August 27th, 1931.—ATTACHING METALS OF WIDELY DIFFERING MELTING POINTS, E. F. Matthews, Elm Cottage, Watford-road, Wembley, Middlesex.

This invention is concerned with the process of making bearings having a steel shell lined with brass or bronze, and aims at the thorough union of the two metals. It is explained that one of the reasons for the difficulty in making this union is the

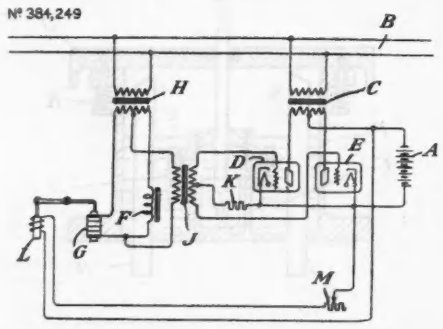


difference in the thermal contraction of the two metals, and also the sudden and temporary expansion of steel at a temperature of about 700 deg. Cent. The inventor consequently heats the steel shell to a temperature of 700 deg. and then casts the brass within it. The heated shell A A is assembled with a core B and the brass is poured through the central gate C, which has radiating passages D at the bottom.—*December 8th*, 1932.

MISCELLANEOUS.

384,249. August 10th, 1932.—ELECTRIC REGULATORS, *The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C.2.*

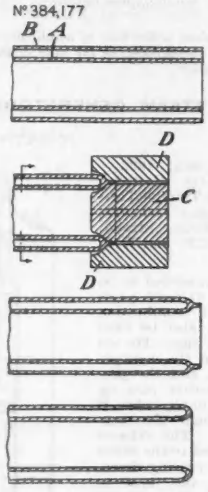
The drawing shows an arrangement for regulating the potential of a direct-current load circuit, illustrated as a battery A, energised from an alternating-current circuit B through a full-wave rectifier comprising a transformer C and electric valves D and E connected in the conventional manner for obtaining full-wave rectification. The valves are provided with an anode, a cathode, and a control grid. The starting of current in a valve is determined by the potential on its control grid, but the current flowing through the valves can be interrupted only



by reducing the anode potential below the critical value. In order to control the output of the rectifier arrangement a phase-shifting circuit comprising a reactor F and a carbon pile resistor G are connected across the secondary winding of a transformer H, the primary winding of which is connected to the alternating-current circuit B. The secondary winding of this transformer is provided with a mid-point connection and the primary winding of a grid transformer J is connected between this mid-point and the junction between reactor F and resistor G. The control grids of the valves D and E are connected to their common cathode circuit through opposite halves of the secondary winding of the grid transformer J and a current limiting resistor K. In order to control the phase relation between the grid and anode potentials of the valves the pressure on the carbon pile G is regulated by a solenoid L and operating mechanism. The solenoid L is connected across the direct-current load circuit A through an adjustable resistor M.—*December 1st*, 1932.

384,177. April 30th, 1932.—SUPERHEATER TUBES, *The Superheater Company, Ltd., Bush House, Aldwych, London, W.C.2.*

This invention concerns the production of tubes nested, one within the other and welded together at the ends. The inner tube A is placed within the outer tube B and is held in place by



means not specified. The end is then raised to a welding temperature and is acted on by the anvil C and rotating swaging dies D D. The fin which is produced on the end is then machined off. The tubes may be thickened at the ends, so that it is not necessary to bend them to make contact.—*December 1st*, 1932.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Monday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

CHEMICAL ENGINEERING GROUP.—Rooms of Chemical Society, Burlington House, W.1. "Corrosion Research on Light Metals," Mr. Freeman Horn. 8 p.m.

INST. OF ELECTRICAL ENGINEERS: LONDON STUDENTS.—Savoy-place, W.C.2. "Signalling Problem of Single-line Railways," Mr. A. Weir.

INST. OF ELECTRICAL ENGINEERS: N.E. STUDENTS.—Armstrong College, Newcastle-upon-Tyne. "Utility of Patents," Mr. I. J. St. A. Crawshaw. 7.15 p.m.

INST. OF MECHANICAL ENGINEERS.—Storey's-gate, S.W.1. "The Compression-ignition Locomotive and its Applicability to British Railways," Lt.-Col. L. F. R. Fell, D.S.O. 6 p.m.

INSTITUTE OF METALS: NORTH-EAST COAST LOCAL SECTION (Joint meeting with Society of Chemical Industry).—In the Electrical Engineering Lecture Theatre, Armstrong College, Newcastle-on-Tyne. "Corrosion of Metals in Salt Solutions and Sea Water," Dr. G. D. Bengough. 7.30 p.m.

INSTITUTE OF METALS: SHEFFIELD LOCAL SECTION.—In the Non-Ferrous Section of the Applied Science Department of the University, St. George's-square, Sheffield. "Metal Spraying," Mr. Kenneth Gray. 7.30 p.m.

JUNIOR INST. OF ENGINEERS.—39, Victoria-street, S.W.1. "Some Practical Notes on Vibration," Mr. J. Calderwood. 7.30 p.m.

KEIGHLEY ASSOC. OF ENGINEERS.—Queen's Hotel, Keighley. "Some Aspects of Modern Foundry Practice," Mr. F. Griffiths. 7.30 p.m.

N. EAST COAST INST. OF ENGINEERS AND SHIPBUILDERS.—Mining Institute, Newcastle-upon-Tyne. "Radiation in Boiler Furnaces," Mr. W. T. Bottomley. 6 p.m.

MONDAY, JANUARY 16TH.

BRADFORD ENGINEERING SOC.—Technical College, Bradford. "Refuse Disposal, and the Petrie and McNaught System," Mr. H. Widdup. 7.30 p.m.

INST. OF AUTOMOBILE ENGINEERS.—At Inst. of Engineers and Shipbuilders in Scotland, 39, Elmbank-crescent, Glasgow. "Electrical Equipment for Automobiles," Mr. E. A. Watson. 7.30 p.m.

INSTITUTE OF METALS: SCOTTISH LOCAL SECTION.—In the Rooms of the Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank-crescent, Glasgow. "Aluminium-bronze," Mr. F. Hudson. 7.30 p.m.

TUESDAY, JANUARY 17TH.

HULL ASSOC. OF ENGINEERS.—Municipal Technical College, Hull. "Cardice and its Uses," Mr. C. E. Paul. 7.15 p.m.

INST. OF AUTOMOBILE ENGINEERS.—Victoria Hotel, Wolverhampton. "Alloy Cast Irons in Automobile Construction," Dr. A. B. Everest. 7.30 p.m.

INST. OF MARINE ENGINEERS.—The Minories, E.C.3. "Oxy-acetylene Welding," Mr. H. P. Smith. 6 p.m.

MANCHESTER GEOLOGICAL AND MINING SOC.—5, John Dalton-street, Manchester. Council meeting, 2.45 p.m. "Illumination in Coal Mines, 1912–1932," Dr. T. L. Llewellyn. 3.30 p.m.

ROYAL INST. OF GREAT BRITAIN.—21, Albemarle-street, W. 1. "Low Temperature and Low Temperature Phenomena," Mr. J. C. M'Lellan. 5.15 p.m.

WEDNESDAY, JANUARY 18TH.

DIESEL ENGINE USERS ASSOCIATION.—Caxton Hall, S.W.1. "Small Marine Diesels," Mr. O. Wans. 3 p.m.

INST. OF AUTOMOBILE ENGINEERS.—Metropole Hotel, Leeds. "Electrical Equipment for Automobiles," Mr. E. A. Watson. 7.15 p.m.

INST. OF CIVIL ENGINEERS.—Great George-street, S.W.1.—Informal meeting. Discussion, "Economic Disposal of Refuse," Mr. J. C. Dawes. 6 p.m.

INST. OF WELDING ENGINEERS.—At Inst. of Mechanical Engineers, Storey's-gate, S.W.1. "Welding in Civil Engineering," Mr. C. Helsby. 7.45 p.m.

NEWCOMEN SOCIETY.—Caxton Hall, S.W.1. "A Cornish Engineer: Arthur Woolf, 1766–1837," Mr. Rhys Jenkins. 5.30 p.m.

ROYAL METEOROLOGICAL SOC.—49, Cromwell-road, South Kensington, S.W.7. "Atoms, Molecules, and the Atmosphere," Prof. S. Chapman, F.R.S. 7.30 p.m.

ROYAL MICROSCOPICAL SOC.—B.M.A. House, Tavistock-square, W.C.1. Presidential address, "Microscope Illumination with Transmitted Light," Mr. C. Beck. 5.30 p.m.

ROYAL SOC. OF ARTS.—John-street, Adelphi, W.C.2. "Recent Developments in Infra-red Photography," Mr. Olaf F. Bloch. 8 p.m.

THURSDAY, JANUARY 19TH.

INST. OF CIVIL ENGINEERS: BIRMINGHAM AND DISTRICT ASSOCIATION.—Chamber of Commerce, New-street, Birmingham "Modern Research Work on Cement and Concrete," Dr. R. E. Stradling. 6 p.m.

INST. OF ELECTRICAL ENGINEERS.—Savoy-place, W.C.2. "By-path Automatic Telephone System," Messrs. J. H. E. Barker and E. P. G. Wright. 6 p.m.

INSTITUTE OF METALS: BIRMINGHAM LOCAL SECTION.—In the University, Edmund-street, Birmingham. "Moulding Sands," Dr. J. G. A. Skerl. 7 p.m.

INST. OF STRUCTURAL ENGINEERS: YORKSHIRE.—Hotel Metropole, Leeds. "Fatigue Stresses in Steel Structures," Prof. F. C. Lea. 7 p.m.

NORTH-EAST COAST INST. OF ENGINEERS AND SHIPBUILDERS: TEES-SIDE BRANCH.—"Castings for Cunarder," Mr. F. Swift. 7.30 p.m.

FRIDAY, JANUARY 20TH.

INST. OF AUTOMOBILE ENGINEERS: WESTERN CENTRE.—Grand Hotel, Bristol. Dinner. 7.30 p.m.

INST. OF FUEL.—University College, Nottingham. "Recent Fuel Developments," Prof. McMillan and Mr. A. Dawe. 7.30 p.m.

INST. OF MECHANICAL ENGINEERS.—Storey's-gate, S.W.1. Informal meeting. Discussion, "Can Engineers Reduce Unemployment?" Mr. T. S. Catmur. 7 p.m.

JUNIOR INST. OF ENGINEERS.—39, Victoria-street, S.W.1. "Notes on Welded Steel Work at Freemasons' Hospital," Mr. S. Bylander. 7.30 p.m.

ROYAL INST. OF GREAT BRITAIN.—21, Albemarle-street, W.1. Discourse, Sir William Bragg. 9 p.m.

SATURDAY, JANUARY 21ST.

HULL ASSOC. OF ENGINEERS.—Municipal Technical College, Hull. "Historical Development of Furnaces Throughout the Ages," Mr. H. Southern. 7.15 p.m.

INST. OF ELECTRICAL ENGINEERS: N.E. STUDENTS.—Visit to Scotswood Works, Armstrong-Saurer Commercial Vehicles, Ltd. 3.30 p.m.

MONDAY, JANUARY 23RD.

INST. OF MECHANICAL ENGINEERS: GRADUATE.—Storey's-gate, S.W.1. "Steam-raising Plant and the Modern Central Power Station," Mr. C. H. Russell. 6.45 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, W.C.2, Howard Lectures, "Thermal Insulation," Dr. Ezer Griffiths. F.R.S. 8 p.m.

WEDNESDAY, JANUARY 25TH.

INST. OF CHEMICAL ENGINEERS.—At Chemical Society, Burlington House, W.1. "Sewage Disposal." "British Practice in Sewage Disposal," Mr. H. C. Whitehead and Mr. F. R. O'Shaughnessy; "Sewage Treatment in America," Mr. L. R. Howson; "German Practice in Sewage Disposal," Dr.-Ing. Karl Imhoff. 5.30 p.m.

THURSDAY, JANUARY 26TH.

INST. OF CIVIL ENGINEERS: YORKSHIRE ASSOCIATION.—Royal Victoria Station Hotel, Sheffield. Annual dinner. 6.30 for 7 p.m.

INST. OF LOCOMOTIVE ENGINEERS.—At Inst. of Mechanical Engineers, Storey's-gate, S.W.1. "Possibilities of the Electric Furnace in the Foundry," Mr. B. R. Byrne. 6 p.m.

FRIDAY, JANUARY 27TH.

INSTITUTIONS OF CIVIL, ELECTRICAL, AND MECHANICAL ENGINEERS: GRADUATES AND STUDENTS.—Victoria Halls, Southampton-row, W.C.1. Dance. 7.30 p.m.

INST. OF ELECTRICAL ENGINEERS.—Grand Hotel, Harrogate. Dinner and dance. 8 p.m.–2 a.m.

INST. OF MECHANICAL ENGINEERS.—Storey's-gate, S.W.1.—"Handling and Storing of Grain, with Special Reference to Canadian Methods," Mr. H. H. Broughton. 6 p.m.

JUNIOR INST. OF ENGINEERS.—39, Victoria-street, S.W.1. "Some Experiments on Reinforced Concrete Slabs," Mr. R. H. Squire. 7.30 p.m.

MONDAY, JANUARY 30TH.

ROYAL SOC. OF ARTS.—John-street, Adelphi, W.C.2. Howard Lectures. "Thermal Insulation," Dr. Ezer Griffiths, F.R.S. 8 p.m.

TUESDAY, JANUARY 31ST.

INST. OF MARINE ENGINEERS.—The Minories, E.C.3. "Pulverised Coal Firing in Marine Scotch Boilers," Messrs. W. G. Gibbons and M. Arthurson. 6 p.m.

WEDNESDAY, FEBRUARY 1ST.

INST. OF CIVIL ENGINEERS: MANCHESTER AND DISTRICT ASSOCIATION.—Midland Hotel, Manchester. Annual dinner. 6.30 for 7 p.m.

THURSDAY, FEBRUARY 2ND.

INST. OF AUTOMOBILE ENGINEERS.—Merchant Venturers' Technical College, Bristol. "Alloy Cast Irons in Automobile Construction," Dr. A. B. Everest. 7 p.m.

INST. OF FUEL.—The University, Bristol. Joint meeting with the Soc. of Chemical Industry. "Elimination of Dust and Sulphur from Flue Gases," Mr. H. E. Wallsom. 7.30 p.m.

FRIDAY, FEBRUARY 3RD.

JUNIOR INST. OF ENGINEERS.—39, Victoria-street, S.W.1.—"Dredging for Alluvial Tin," Mr. H. W. Sewell. 7.30 p.m.

SOUTHERN RAILWAY PUPILS' AND PREMIUM APPRENTICES' ASSOCIATION.—Charing Cross Hotel, W.C.2. Annual dinner. Tickets may be obtained from Mr. E. Forge, 159, Desborough-road, Eastleigh.

SATURDAY, FEBRUARY 4TH.

INST. OF BRITISH FOUNDRYMEN: LANCASHIRE.—Grand Hotel, Manchester. Annual Whist Drive, Dinner and Dance. 4 p.m. to Midnight.

MONDAY, FEBRUARY 6TH.

ENGINEERS' GERMAN CIRCLE.—At Inst. of Mechanical Engineers, Storey's-gate, S.W.1. "A Review of Iron and Steel Manufacture," Herr Victor B. Reichwald. 6 p.m.

ROYAL SOC. OF ARTS.—John-street, Adelphi, W.C.2. Howard Lecture, "Thermal Insulation," Dr. Ezer Griffiths, F.R.S. 8 p.m.

THURSDAY, FEBRUARY 16TH.

INST. OF ELECTRICAL ENGINEERS.—Grosvenor House, Park-lane, W.1. Annual dinner and reunion. 7 p.m. for 7.30 p.m.

A Seven-Day Journal

President-Elect of the F.B.I.

AT a meeting of the Grand Council of the Federation of British Industries, which took place on Wednesday of last week, January 11th, Lieut.-General Sir George Macdonogh was nominated to succeed Sir George Beharrell as President of the Federation for the coming year. Subject to the confirmation of the appointment, Sir George will enter upon his new office in April. Sir George Macdonogh was born in 1865 and entered the Army in 1884. He is a Colonel Commandant, Royal Engineers, and during the war, after a distinguished military career, filled the appointment of Director of Military Intelligence from 1916 to 1918, and from 1918 to 1922 served as Adjutant-General to the Forces. Since his retirement from the Army he has filled many important positions in both civil and industrial life. He was called to the Bar in 1897, and has acted as a member of the Executive Council of the International Law Association. From 1923 to 1929 he served on the Royal Commission on Local Government. He is connected with the Shell Royal Dutch Group, is a fellow of the Institute of Bankers, and a member of the London Committee of the Hong Kong and Shanghai Bank. He is also chairman of International Paint and Compositions, Ltd., of Scammel Lorries, Ltd., and of Watts Fincham (1932), Ltd., is a director of Venezuelan Oil Concessions, Ltd., the National Provident Institution, and International Paint (Canada), Ltd., and a member of the Council of the Royal Institute of International Affairs.

New Railway for Australia.

PROPOSALS for a new railway nearly 1700 miles in length are outlined in a memorandum issued in Australia and forming a basis for the negotiations now reported to be taking place between the Government and a board upon which several eminent industrialists are serving. According to the main proposals, a railway line of 4ft. 8½in. gauge would be built to connect Darwin on the coast of North Australia with Bourke in New South Wales, the present terminus of the line of that gauge in the latter State. Apparently connection would be made with the western railheads of a number of the narrow-gauge railways of Queensland. It is also proposed to connect the existing line between Darwin and Birdum, at present of 3ft. 6in. gauge, to the 4ft. 8½in. gauge of the new line. The cost of the undertaking, which would take between three and five years to complete, is, according to present estimates, £15,000,000, and it is said that the Federal Ministry is ready to co-operate in carrying it out. The negotiations with the Government are concerned with the acquisition of rights by the railway over about 50,000 square miles of territory, guarantees as to maximum rental, and powers to create towns and villages, to cultivate and irrigate, and to carry on mining operations.

An Interesting Appointment.

OUR readers will be interested to hear that Mr. A. E. Mascall has been appointed general manager of the Parkhead Works of William Beardmore and Co., Ltd. We understand that whilst Mr. Mascall will be responsible for the output of the Parkhead Works as a whole, particular advantage will be taken of his great experience in the manufacture of heavy forgings, and especially hollow, high-pressure vessels and seamless steel boiler drums. Many of our readers are aware that up to the end of last year Mr. Mascall was in charge of the heavy forges and rolling mills at the Atlas Works of John Brown and Co., Ltd., Sheffield. When it is remembered that Mr. H. A. Reincke, the chairman of William Beardmore and Co., Ltd., spent several years at the Atlas Works, it is not surprising that he should have seized upon the opportunity offered by the services of a man with Mr. Mascall's experience becoming available at the moment when the placing of Admiralty orders on the Clyde is likely to cause increased calls on the capacity of the Parkhead Forge. We are informed that Mr. Mascall has already taken up his duties at Parkhead.

Finnieston Bridge.

TOWARDS the end of last year we reported in a Journal note that the project for a Finnieston Bridge at Glasgow had been revived. The matter has now been carried a stage further forward by the deliberations of the Streets and Buildings Committee of the Corporation, which met last Friday, January 13th, to consider the report on the subject submitted by the Cross-River Communications Sub-Committee. As a result the Corporation was recommended yesterday, January 19th, to go forward with the scheme. Most of the matters that influenced the Streets and Buildings Committee in making its decision were concerned with finance. According to a statement of the City Chamberlain, the total capital expenditure to date incurred by the project—which, it will be remembered, received parliamentary sanction nearly six years ago—was £439,088. If the work on the bridge is not continued it will be necessary to find temporary accommodation for the Finnieston ferry in order that the Clyde Trustees may make use of the 170-ton crane erected in anticipation of the construction of the bridge. It is estimated that the total cost of running the ferry would be in the neighbourhood of £40,000. According to the City Chamberlain, the bridge could probably be completed by 1938–1939 at a cost, including the purchase price of various properties, of £1,220,000. According to his calculations, the heaviest charge on the rates, occurring in 1939–1940, would be rather more than 1½d. in the £ if the bridge were built, whereas if it was decided not to proceed with the scheme the heaviest charge would be rather less than ¾d. in the £ at the highest point in 1935–36.

A Large Coke Grading Plant.

A LARGE coke-grading plant, with a capacity of 120 tons per hour, is to be supplied by Simon-Carves Ltd., of Cheadle Heath, Manchester, for the Chesterfield works of the Staveley Coal and Iron Company, Ltd. It will be designed to deal with the coke from the company's own ovens, and that from outside sources, and to produce furnace coke and four different grades of domestic coke. There are to be two coke wharves with finger gates, and the primary screening house will contain, besides two grizzley screens, one a standby, a coke cutter to augment if desired the supply of small coke. In this house the furnace coke will be separated from the small coke which, in a secondary screen house, will be divided into the four grades. A four-hopper bunker, constructed in ferro-concrete, will be used for storing and loading the small coke. To deliver the coke from the wharves to the primary screen house use will be made of a 42in. belt conveyor, about 440ft. long, with a designed capacity of 120 tons per hour. From the primary screen house furnace coke will be loaded either direct into wagons by a 42in. boom-loading conveyor, or it will be transported on a 36in. cross conveyor, some 470ft. long, fitted with an automatic weigher, to a longitudinal conveyor arranged over the blast-furnace bins, delivery being effected from the belt by a travelling tripper. Both the cross and delivery belts will have a capacity of 110 tons per hour. All the plant is to be electrically operated, with the motors arranged for control from any part of the system, and the whole of the conveyor plant will be fully sheeted as a protection against weather.

The Railway Wages Reports.

THE National Wages Board, which has been considering the claim by the railway companies that the present percentage reductions from the earnings of railway workers shall be replaced by a deduction of 10 per cent., issued its findings on Friday last, January 13th. They took the form of six separate reports, creating a position which has been not incorrectly described as confusing, chaotic, and anomalous. The Chairman, Sir Harold Morris, for the first time in the history of the Board; was left to sign a report alone. He recommends a reduction in wages and salaries totalling only about one-fifth of the full saving of about £4,500,000, which would be made if the full claim of the companies were conceded. The other five independent reports comprise one from the representatives of the railway companies, one from the representatives of the railway trade unions, and separate reports from Mr. H. J. May, of the Co-operative Union; Mr. A. Pugh, of the Trades Union Congress General Council; and a joint report from Mr. Wallace Thorneycroft, of the Federation of British Industries, and Sir Gilbert Vyle, of the Association of British Chambers of Commerce. On Tuesday, January 17th, the railway companies had under consideration the report of the Board and the position thereby erected. At the close of their meeting it was announced that, while the finding of Sir Harold Morris, the independent Chairman of the Board, falls, in the opinion of the companies, far short of the merits of the case which they presented, they are prepared to accept it, and they have communicated with the unions accordingly.

Asphalte.

ON Tuesday last a small luncheon party was held at the Café Royal, under the chairmanship of Mr. F. M. Bond, of the Limmer and Trinidad Lake Asphalte Company, Ltd., to inaugurate the Natural Asphalte Mine-Owners and Manufacturers Council. To understand the purpose of this Council it must be explained that at the present moment the constitution, preparation, and use of asphalte for use in buildings are entirely unstandardised, with the natural consequence that the architect or engineer who specifies asphalte for the covering of roofs or for use in basements has no assurance that the material or the method by which it has been prepared and laid, will give permanently satisfactory results. To overcome this defect the Council has been formed by the agreement of thirteen asphalte companies which hold a leading position in this trade in the United Kingdom. These thirteen companies have, after two years' work, agreed to a specification of quality, and have established an organisation which will ensure to architects security supported by warranty. We understand that it is not the intention of the Council for the present, at least, to publish its specifications, but they will, of course, be available to all members of the Council, whilst the user will be protected as far as the material is concerned by the employment of a special shape—a triangle—for the blocks of asphalt and by a trade mark. It is the intention of the Council that all the factories under its control shall be controlled and registered. The Council has laid down standards of manufacturing practice and equipment, and will only grant permits to manufacture its standard materials at factories which have been approved and registered. But the Council's responsibility will not cease at the stage of manufacture. In order to ensure that the asphalte is carefully applied on the contract, a Standard Code of executive practice has also been drawn up, which all companies represented on the Council undertake to observe.

The Shipbuilding Industry.

SINCE the beginning of the year, there have been several small, but not unwelcome, shipbuilding orders which mark a long-awaited revival in the shipbuilding industry. In addition to the large motor cargo ship which Swan, Hunter and Wigham Richardson, Ltd., are building at their Wallsend yard, on open account, in order to give employment to their staff and workmen, the firm has recently booked an order for a 1000-ton oil barge for Canadian owners, which will be welded throughout and will be the first of its kind built on the Tyne. It may be recalled that some time ago the Tyneside Boilermakers' Society arranged classes for the training of shipyard workers as welders. On the Clyde, the engines for the Swan, Hunter motor ship will be constructed at Barclay, Curle and Co.'s Whiteinch Engine Works, and we learn that they are to be of the Barclay, Curle Doxford opposed piston type. During the week, an order was placed with Scotts Shipbuilding and Engineering Company, Ltd., for a ship for London owners, and the Admiralty has given Yarrow and Co., Ltd., Scotstoun, Glasgow, the contract for H.M. gunboat "Robin," of the 1932 programme.

Coastal Trade Development Council.

IN a Journal note of December 30th, we referred to Earl Beatty's appeal for a national effort to preserve our coastwise traffic, and to the formation of a Coastal Trade Development Council, with Sir John Sandeman Allen as its chairman. In a letter addressed to those who, in the past few weeks, have come forward with expressions of goodwill and offers of help in the movement, Sir John Sandeman Allen points out that it would be a disservice to the campaign which has been begun if no attempt were made to correct the popular fallacy that the decline of coastal shipping is rooted in foreign competition. While it is true that a certain amount of port-to-port trade is lost to British shipowners by foreign craft accepting coastwise shipments, this practice is apt to be viewed in larger perspective than the facts warrant. The future of our coastal ships lies, Sir John maintains, largely, if not mainly, in the hands of those engaged in the movement, distribution, and trans-shipment of goods, both imported and of home manufacture. To all such, Sir John gives the assurance that our coastal services already provide an efficient nucleus for the development of coastwise shipping, and offer transport facilities that are well worth investigating.

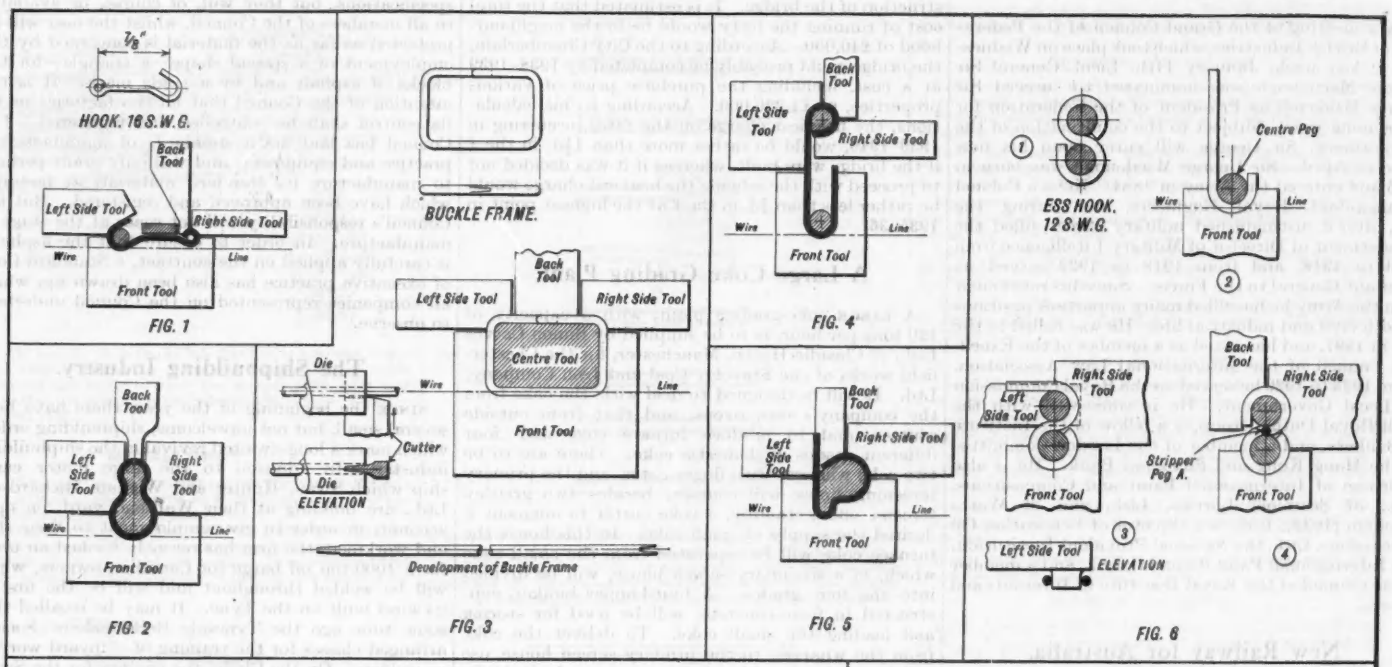
The Electricity Grid.

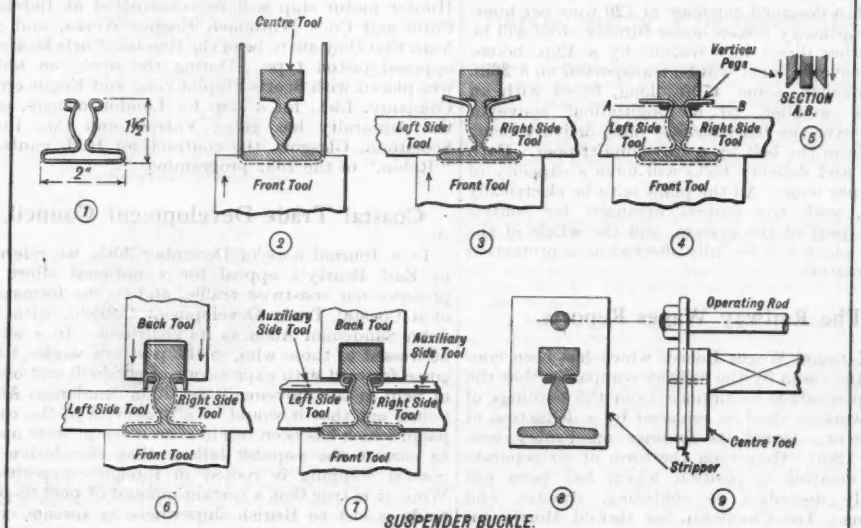
IN the course of a speech made at the annual dinner of the Electrical Contractors' Association (Incorporated), which was held in London on Tuesday evening last, Sir Andrew Duncan, the Chairman of the Central Electricity Board, referred to the progress made in the completion of the electricity grid. He pointed out that while the Board has so far been engaged in the task of construction, it would, this year, he hoped, establish itself as a trading concern with country-wide ramifications. When the grid was completed, the supply industry would have at its command a powerful productive machine, highly efficient and flexible, which would defy competition. An important point to remember was the fact that the great bulk supply undertakings would find it unnecessary to expend their capital upon generating plant, but would be in a position to devote the whole of their resources to the intensive development of distributive systems. On the production side, there would be ordered progress, and, in his own opinion, the wholesale conversion to electrification in this country was inevitable. Other speakers appealed for the maintenance of good service based on good work and fair prices, a standardisation of a supply pressure of 230 volts throughout the country, and more stability in the charges made for electricity.

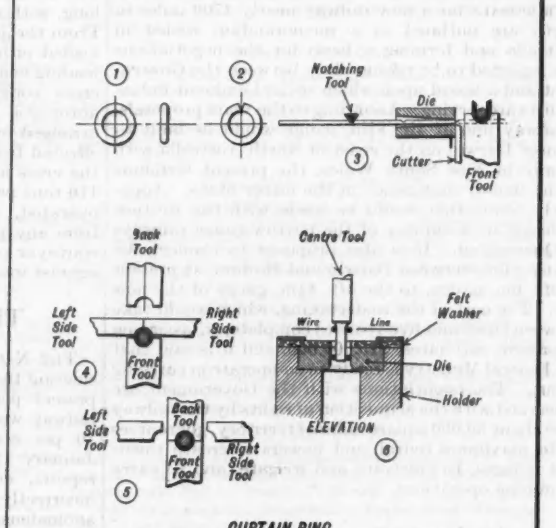
AUTOMATIC HIGH-SPEED WIRE AND STRIP FORMING MACHINE

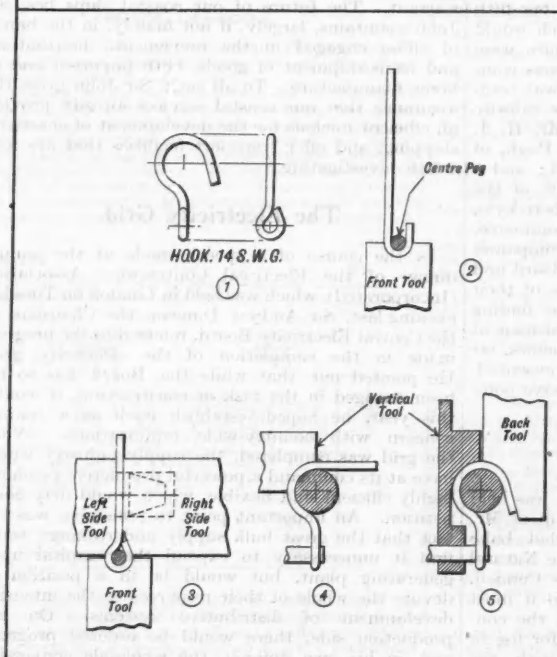
JAMES WARD (WORCESTER), LTD., WORCESTER, ENGINEERS

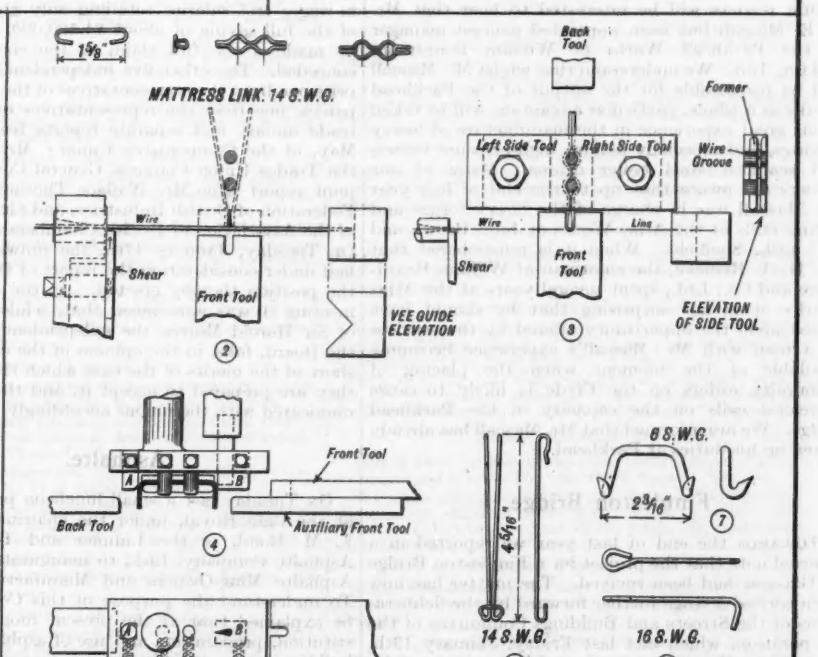
(For description see opposite page.)











SKETCHES SHOWING SEQUENCE OF OPERATIONS IN MAKING WIRE FORMS

An Automatic Wire-Forming Machine.

AUTOMATIC machines for the conversion of plain, drawn wire into more or less elaborate forms have, of course, been in use for generations past—principally in the Birmingham district—and we believe that there is still at work a machine which was originally used for making military accoutrements for the Crimean War. These machines were of a comparatively crude construction, and were most ingenious, in view of the materials of construction then available. They were, however, more or less confined to their individual jobs.

The machine which we describe and illustrate below is really a development of those old machines, but its mechanism bears little comparison, as it depends for its high-speed action on the maintenance of very fine limits of measurement, by means of a high standard of primary construction and the employment of materials which will maintain that standard. It, or, rather, they, for there are several types, are made by James Ward (Worcester), Ltd., of Broad-street, Worcester.

The broad principle of the machine is to provide round a square table a set of four horizontal intergeared shafts, on any or all of which cams can be arranged to operate tools for forming the wire. There is also a wire straightener, a feed mechanism, a cut off, and a stripper. For some shapes a fifth slide is provided, working in a vertical direction for operating a mandrel, round which the wire is bent. It should, perhaps, be pointed out here that the wire may be of any cross section and may be so flattened that it becomes strip.

Starting with the straightener, the wire is passed, in the familiar manner, between staggered rollers, which bend it back and forth to a gradually decreasing extent, and finally deliver it quite straight. The feed mechanism comprises a pair of grips, opened and closed by a short transverse lever, which slides underneath a horizontal plate hinged after the manner of a box lid. This plate is raised and lowered by a lever and cam on the front shaft—that is to say, the front one of the four which surround the table—to open and close the grips. The grips are mounted on a slide, which is reciprocated by the heavy lever seen on the left of the machine in the engraving, Fig. 17, on page 70. During the stroke the wire is held in the grips by the box lid plate holding down the lever, although the latter is free to slide in the direction of the feed. The length of stroke can be adjusted by varying the stroke of the driving crank. It will be noticed that the connecting-rod to the feed slide is offset from the side of the lever, so that the thrust is in the centre of the slide and there is no side wear. When the wire has been fed forward, a second pair of—fixed—grips comes into action and prevents it being drawn back again by the receding slide. In front of the fixed grips the wire runs through a short tunnel at the exit from which it is cut off by a transverse shearing blade. The wire is not, however, cut off until it has been gripped by at least one of the forming tools. The feed grips then release it.

The subsequent parts of the machine are, naturally, dependent on the part that is to be made; but they are bounded by the four, or possibly five, slides already mentioned. The actions will best be described by some notes which follow, but there are some generalities in connection with the mechanism which may be explained here. First, there is ample room on the length of any of the shafts, and they are stiff enough between their bearings, for the attachment of more than one cam. As a consequence, there may be superimposed upon any one of the slides one, or perhaps two, auxiliary slides, with their own cams, which may be used to follow up the action of the main slide. The result is that a very considerable number of operations can be performed on the wire during one revolution of the machine.

Secondly, the cams which operate the slides are of the double-race type. That is to say, the slide is positively moved by the cam in either direction, and does not depend on a spring for its return. The result is that both strokes are absolutely defined in their extent without any possibility of jumping over high points on the cam when running at high speeds, or of the tools not retiring from the work. The main cams have a track cut in their sides into which the roll on the end of the connecting-rod fits with only a rolling clearance, so that the hardened inner face of the track pushes in the slide and the outer face pulls it out again. These cams are made with a high degree of accuracy and we could detect no backlash in their action, but we are not at liberty to explain the process of manufacture of the track. Adjustments are provided so that the exact position of the tool can be determined regardless of the extent to which it may have to be ground. There is a general system of indexing between the various parts, so that, should a machine have been once set up for any individual job, it can quickly be reassembled with the component parts in the proper positions, the makers having devised a simple system of records for the purpose.

A noteworthy feature about the machines is that, despite their rather complicated character, should it be necessary to dismantle any one part, on account, say, of accidental damage, that part can generally be got at without disturbing other parts of the machine. The drive is transmitted through a fast pulley and clutch on a countershaft, on which there is also a fly-wheel that forms a very convenient means of pulling over the machine slowly when setting up tools, through gearing to the end cam shaft. The other three shafts are driven from it through mitre gears.

We will now endeavour to explain the action of the tools in making several typical wire forms, and although the reader will appreciate, as he progresses, that to give here a really detailed description of all the movements, would involve the occupation of far too much space, we trust that his imagination will fill in the gaps. These notes are illustrated by a number of sketches kindly prepared for us by Mr. T. Hanson, the inventor of the machine, and, in general, show the sequence of operations, although, in the simple cases, the parts are shown at the completion of the stroke.

Thus, in Fig. 1, a little hook of No. 16 S.W.G. wire, used to couple toy locomotives, is shown finished. The wire is fed forward along the axis marked "wire line," and is cut off from the stock as the front tool advances and bends it round the two round and one flat pegs (cross-hatched) that form the centre tool held in the centre tool post. The left and right side tools then continue the bending, while the front tool holds the wire firmly. The back tool comes in to complete the bending of the eye, and when all these tools have retired, a stripper plate on the vertical stripper pushes the finished hook off the pegs.

In the cases of Figs. 2, 4 and 5, little comment is necessary; but they are interesting through showing how only four tools can be combined to produce many shapes in one plane.

The peculiarity of the example shown in Fig. 6, that of the "S" hook, is that one of the side tool operations is performed by a peg, rather than by a grooved tool to facilitate stripping. The first movement is plainly indicated in the sketch 2, and in the next by the left side tool, which carries the peg just mentioned. The peg is shown in elevation at 3. It bends the wire over the centre peg while the right-hand tool completes the curvature on that side. The back tool then comes in to finish the hook, and it is stripped by a peg A on the vertical stripper, as shown in sketch 4.

The chief interest in the making of the buckle frame shown in Fig. 3 lies in the system of cutting off to provide the dovetailed joint. The wire is fed forward through a close-fitting tunnel or die, across the front end of which there is cut a slot, as shown in the two left-hand sketches of Fig. 3. The cutter takes, rather, the form of a punch, which punches out the slot for the dovetail and leaves the tongue on the end of the other wire. There is thus no loss of metal in making the joint, which is both strong, and is not liable to fray any cloth with which it comes in contact.

In Fig. 7 there is illustrated a more complicated form, in a single plane. It is one part of the buckle for the shoulder straps of an engineer's overall, and requires about 7½in. of wire. Its shape is shown in the sketch 1. The wire is fed forward in front of the centre tool, cut off, and bent round the centre tool by the front tool, as shown at 2. The side tools then advance and close in the wire into the waist, but they cannot close in the waist to the top—see 3—as they would then be in the way of the mandrels for the two eyes.

These mandrels, which are on the auxiliary vertical slide, have tapered ends, as is shown in the sketch 5, and draw the wire into the corners of the centre tool, see sketch 4. The back tool then partially wraps the wire round the mandrels—sketch 6—and two auxiliary side tools complete the closure. The stripping action is illustrated by sketches 8 and 9, where, it will be seen, the stripping plate embraces the centre tool.

Another example of work in one plane is given in Fig. 8. It is that of a plain ring made of comparatively heavy gauge wire to a small radius, and the desire is to make the ring as neat as is possible, as is shown in sketch 1, and not with a gaping joint, see 2, which would be the result of shearing off the ends of each length of wire squarely. So before the wire arrives at the cutting-off die, it is cut across by a notching tool, which makes a V notch almost, but not quite, through the diameter of the wire, see sketch 3. The length of wire is cut off, and bent into a U by the front tool round the mandrel. The ring is then formed by the side tools, 4, and the back tool comes in to consolidate the ring after the side tools have retired, 5. If rings of a very exact diameter are required, they are finally pushed through a die plate, as shown in sketch 6, by a downward movement of the centre tool or mandrel.

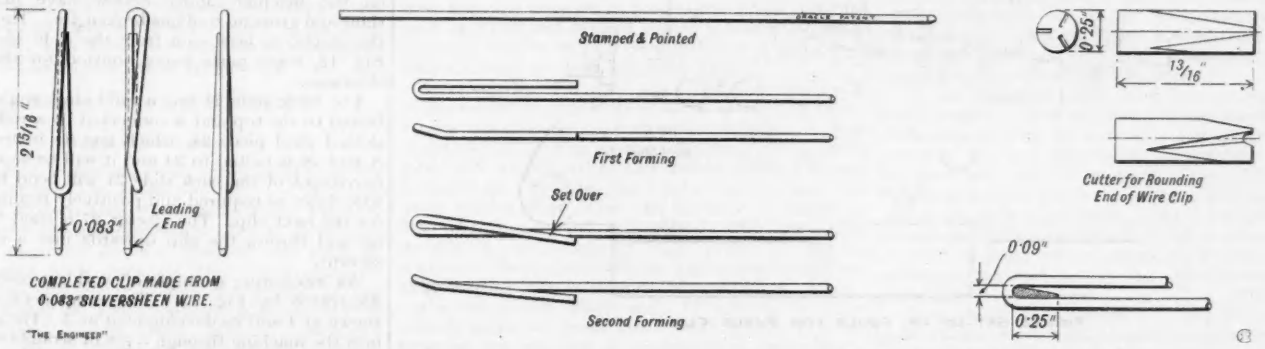


FIG. 11—COMPLETED PAPER CLIP, SEQUENCE OF OPERATIONS, POINTING TOOL AND CENTRE TOOL

We now come to wire forms made in two planes, a simple form of which is demonstrated in Fig. 9. The wire, having been cut off is bent by the front tool round a centre peg, as shown in the sketch 2. The two side tools then advance, but the left side tool is preceded by a tapered snout shown by broken lines, which bends the long end of the wire upward. This snout is accommodated in a recess in the right side tool, as shown in the sketch 3. The right side tool then retires and leaves room for the vertical tool, see 4, to continue the bend over the peg. Finally, as the stripper plate arrives, 5, the back tool completes the hook. Should it be desired that the hooking goes past the diameter, the end of the back tool is hinged to the body, and rides up over a cam-faced slide at the end of the stroke to wrap the wire round the centre tool. The peg on the left side tool is, of course, retracted in time for the stripping action.

In Fig. 10 there is illustrated a rather more elaborate form in two planes. It is that of a mattress link, see 1, while the sketches 6–8 include several other forms made by much the same process. The mattress link is made of No. 14 S.W.G. wire at the rate of 120 a minute.

In view of the considerable length of wire necessary to make this link, it is projected across the gap between the front and centre tools into a V notch, which prevents it from sagging under its own weight. It is then cut off, and the front tool bends it round into a hairpin form, as shown by the dotted lines, see 2. The two side tools advance and squeeze the wire round two pegs carried by the stripper plate, see 3, which also gives an elevation of the end of the side tools. It will be seen that below the groove in which the wire lies there are two formers for the end hooks. On the stripper plate there are two extra pegs A and B, see 4 and 5, which are slightly shorter than the centre pegs. It will be noticed that the peg B has a passage for the centre tool referred to in connection with the operation shown in 2. The continued downward movement of the stripper plate brings the pegs A and B against the wire and bends it downward, as shown in 4. An auxiliary front tool and the back tool then complete the hooks. The finished link is still held by the side tools, so that the stripper plate is raised, to take away the pegs, and on the side tools opening the link drops out.

A very interesting piece of wirework in several planes is that indicated in Fig. 11. It is that of a paper clip devised by the late Dr. Loveday for holding a daily paper, so that the pages can be conveniently turned over without falling apart. It is intended to be kept in the pocket and slipped into the crease of the paper before it is opened.

One of the charms of this series of mechanisms lies in the fact that the doctor—there is a great affiliation between doctors and engineers—made wooden models of all the essential parts for producing this clip before submitting it to Wards for manufacture. There has been little necessity for altering his original arrangements.

The clip, as will be seen from Fig. 11, is what might be described as of " trivett " shape, and entails some very close folds. Incidentally, the leading end of the wire must be pointed, for convenient insertion between the folds of the newspaper. This pointing is one of the controlling operations as to the speed of production, but yet the clip is produced at the rate of sixty per minute.

The machine itself is represented in two of our half-tone engravings, Figs. 15 and 16, while the essential tooling is illustrated in Fig. 12. The machine, as will be seen from the illustrations on page 70, is driven by a belt on a fast and loose pulley, and the fly-wheel, to which reference has already been made, will be noticed. The wire-straigtening device will be readily identified on the right side of the illustration.

The machine, in its general characteristics, is very similar to those already described, except that the centre tool—that round which the first operation is performed—is supported from below, instead of being carried by the overhead slide. The finished piece must, consequently, be stripped upward.

The wire is fed forward to the extent of some 7in. through the straightening rollers 1 by the feed slide 2, and is then held by the grippers 3—see the photographic plan view. It passes under a guide 5 (see Fig. 12) to prevent it jumping over the centre tool, which projects only 0·09in. above the tool block. The wire is then ready for the action of the four sets of tools common to these machines, which work around the centre tool 6. The wire enters a sheet metal guide 7, which guides it into the dies for lettering 8, when the full length of wire has been fed it is then ready for lettering and pointing. The lettering, which amounts to the punching of the words " Oracle Patent," is effected by a vertical slide 9 actuated by a lever 10, and at the instant the wire is gripped by the dies the revolving cutter 11 is moved forward by a cam on the gear, shown in the photograph, and quickly rounds the end. This spindle is driven at a speed of 5000 r.p.m. by a small electric motor, shown in the engravings, but not in the line drawing.

As soon as the dies and cutter are clear of the wire the front tool 12 moves forward and at the same time the wire is severed by the shear 13. In the front tool there is a wedge-shaped piece 14, which forms the " lip " as well as bending the two arms parallel, since the centre tool is hinged and disappears into the tool block. The long end of the clip has, of course, to pass over the right-hand tool, otherwise a very long movement of that slide would be required for its retirement. The edge A of 15 is consequently tapered off below the wire, and as the front tool bends the wire it is lifted over the tools by the taper, and the end drops snug into the position groove 16. The shape of the wire at the completion of the front slide stroke is shown in Fig. 11, and the next operation is for the left-hand tool to set the short arm over ; this tool 17 now moves in and the short arm is set and is actually set over the long arm.

Now, this setting operation raises a difficulty, as will be readily appreciated. The clip has to have the long arm bent back on itself, so a tool 18 fixed to the right slide is moved in and over the bottom part of the wire, but unless the short end is moved temporarily away the bending would smash the tool. A spring plunger 19 is therefore also mounted slightly in advance of the forming tool 18 and pushes the short arm away until the tool 18 is in position, when it cannot return. The plunger 19 must be moved out of the way of the last forming tool, which is operated by the back tool, and this action is effected by a wedge piece 20, which is bolted to the back slide, and as it moves forward pushes back the plunger.

The method of obtaining the last bend involves an interesting mechanical device and was designed to reduce the pressure on the tool 18, which is only 0·090in. at its thickest part, and although the tools on the machine under review have made some thousand gross no tool has broken yet. The action of this device is best seen from the side elevation of Fig. 12, some parts being omitted for the sake of clearness.

The back slide 21 has a mild steel angle piece 22 bolted to the top and is connected by a roller 23 to a slotted steel piece 24, which has its fulcrum at 25. A tool 26 is bolted to 24 and it will be seen that the movement of the back slide 21 will bend the arm of wire down as required and positively return the tools for the next clip. The ejector 27 is then " flipped " up and throws the clip upwards into a chute (not shown).

An interesting example of work on metal strip is illustrated by Fig. 13. The component, a clip, is shown at 1 and its development at 2. The strip is fed into the machine through a set of straightening rolls, such as that already described, and is then acted upon by the dies shown in 3 and 4. The first two dies A and B merely stamp lettering on the blank and are consequently opposed by a solid part of the bolster. The next punches C–F make holes right through the strip and the punchings are ejected through the bolster. The strip is then moved on another length of feed and its exterior contour is cut out by the die. The blank is finally cut off and is formed by the four tools, as shown in the sketches 5, 6, 7, which need no description.

The last example which we illustrate in Fig. 14 is also made of strip. It is a component for a wireless valve and is of nickel, No. 14 gauge. Before it was made in the Hansfield machine this component was joined by welding, but now it is seamed automatically at the rate of 100 a minute, and the makers are saved some four million handlings a year.

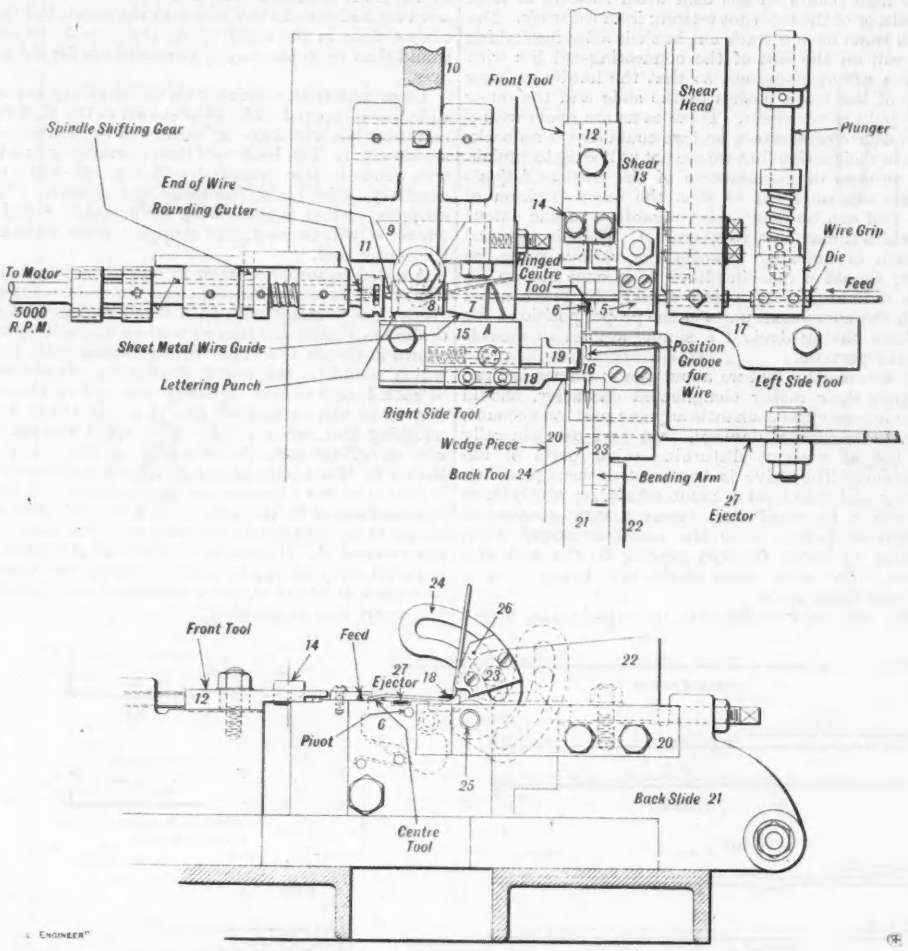


FIG. 12—SET-UP OF TOOLS FOR PAPER CLIP

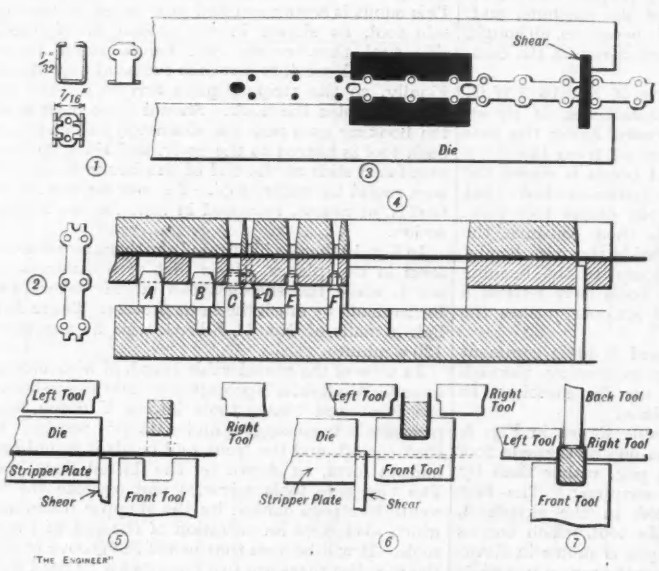


FIG. 13—MAKING STRIP CLIP

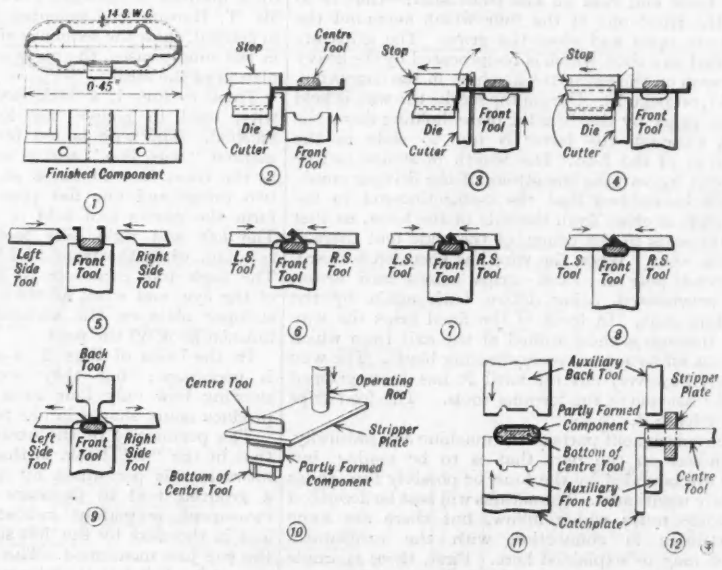


FIG. 14—STRIP COMPONENT WITH FOLDED JOINT

In cutting off the piece of strip the end of the stock is bent up against a stop (see 2), and it is then nipped off, so that the piece has reversed flanges. The stop has to be got out of the way before the front tool can bend the piece in the direction shown by the arrows in 3, so it is pushed back by a wedge attached to the side of the front tool (see 4). The side tools then make the folded joint (see 5–8) and the back tool tightens the joint (9). The completed band is then pushed down the centre tool by the stripper plate (see 10), but does not fall right off, as it is held by a catch plate (see 12). The bottom of the centre tool has ribs formed on its sides to give the final shape to the component under the influence of auxiliary front and back tools (see sketch 11). The catch plate retires and the finished piece drops off as the next one arrives.

We have not attempted to describe the full range of forms which can be made in these machines, but the examples which we have given indicate their capacity. The material worked upon may range from the finest gauges up to ¼in. diameter. It is noteworthy that among the many examples we have inspected we have not found one piece bruised or damaged.

The International Railway Congress.

No. I.

THE twelfth meeting of the International Railway Congress Association is being held in Cairo this month. The permanent Commission received the delegates at the Heliopolis Palace Hotel, on Wednesday, January 18th, and the Congress was formally opened by the King of Egypt yesterday—Thursday. Amongst the reporters are Sir Henry Fowler, Mr. H. N. Gresley, Mr. A. Newlands, Mr. E. C. Cox and Mr. G. H. Crook. These are the only British railway officers who are delegates. Mr. Douglas Vickers, a director of the London, Midland and Scottish, and Sir Evelyn Cecil, a director of the Southern, are members of the executive committee of the permanent Commission, and Sir Francis Dent represents the Railway Clearing House. There are also two directors from the Great Northern of Ireland. The two delegates from the British Government are Mr. E. W. Rowntree and Lieut.-Colonel Mount.

The consideration of the thirty-six reports on thirteen subjects is divided among five sections, of which Sections I. and II. deal with civil engineering and mechanical engineering respectively. We propose to, as usual, summarise the six reports to be dealt with therein, also the three reports on automatic train control that come before Section III.

SECTION I.—WAYS AND WORKS.

LEVEL CROSSINGS.

This section is dealing with three questions, the first of which is "The Protection of Level Crossings in View of Modern Developments in Road Traffic." Thereon there are three reporters—Mr. A. Newlands, chief civil engineer, London, Midland and Scottish Railway, who takes America, the British Empire, China, Japan and Egypt; Monsieur Baticle, of the French Ministry of Public Works, who reports on Belgium, Spain, France, Italy, Holland, Portugal, and their Colonies, Denmark, Finland, Luxemburg, Norway, Sweden, and Switzerland; Mr. Miszke, of the Polish Ministry of Communications, who deals with all the other countries.

Mr. Newlands opens his report by observing that the existence of a railway crossing over a public road must obviously create some restriction on freedom of movement along the road. In the early days of railways this restriction was not of the same moment as it is to-day, owing to the more leisurely manner in which the pedestrian and horse-drawn traffic of those days moved along the roads, as compared with the speeds at which modern motor vehicles traverse the same routes to-day. A check of five minutes at a level crossing on a horse-drawn vehicle moving at 10 m.p.h., only represented the time spent in travelling about 800 yards, whereas it might represent to-day, in the case of a motor-driven vehicle, the time spent in travelling a distance of 4 or 5 miles. Owing to this change in the speed of traffic on roads the incidence of accident at railway crossings has entirely changed, since much more care is called for in approaching railway crossings at the high speeds of to-day than was necessary at the former low speeds.

There appears to be no uniform method in operation whereby roads, and the railway crossings on them, in the various countries under review, are classified with regard to their importance. In some countries classification is based upon the importance of the road as affording communication between large centres of population. In others it is based on the density of traffic on the roads, while in some—notably in Japan—the level crossing classification is based upon the extent to which trains pass over it. The Japanese method seems to commend itself as giving the most reliable indication as to the delay and risks that would be attendant on the use of a level crossing.

In Great Britain roads are designated first-class when they connect important cities or towns, and second-class when they connect with first-class roads. The classification does not give consideration to the extent to which a road is used by the public, nor to the width and constructional type of the road itself.

On the subject of statistics relative to accidents, Mr. Newlands quotes from the annual accident report for 1930, which said that, in spite of the intensive character of present-day road traffic, an examination of the statistics of accidents and casualties at public road level crossings justified the conclusion that danger to the public from the existence of crossings was not on the increase.

An important point made by the reporter is that the railway companies do not report the cases in which public road vehicles run into closed gates at level crossings. Such accidents may be taken as due to want of care on the part of the road user, and although they involve no personal injury they cause considerable material damage both to vehicles and to the property of the railway companies, and, what is of more importance, each such occurrence is a potential source of accident which might involve serious injury or loss of life.

In the United States of America it is found, from statistics published by the Interstate Commerce Commission for 1929, that during the previous thirteen years the number of motor vehicles increased more than five-fold, while the number of killed and injured in connection with motor vehicle accidents at level crossings about doubled itself. It is of interest to note that the proportion per 10,000 motor vehicles, both in killed and injured, shows a steady decrease, dropping from 0·90 to 0·64 killed, and 2·98 to 1·91 injured during the six years 1925–1930.

American opinion may urge that the diminution in the record of accidents is to be attributed to the increased number of fixed signs and signals now used, as against the passing practice of having level crossing gates and watchmen, as the former method of protection is seen to be on the steady increase, while the latter is decreasing. One has, however, to remember that the number of accidents is also decreasing steadily in Great Britain, where practically no use is made of fixed signs and road signals, and gates and watchmen are the usual form of protection.

The conclusion which may be arrived at, after consideration of these facts and figures, is that, although the number of vehicles—especially quick-moving—on the roads has increased to an enormous extent—in Great Britain, as an example, roads have had to be widened and new roads constructed in order to cope with the growth of road traffic—yet the number of accidents at level crossings, instead of rising at the same rate as the increase of vehicular traffic, is actually showing a steady decrease. It may be inferred, therefore, that road users are, of necessity, becoming more observant and more vigilant in using the roads. They are on the look-out for signs and obstructions, and are, consequently, not taken unawares when they come upon an unexpected level crossing, closed by a gate or otherwise protected. A further point is that the increasing use of the roads is developing a "road sense" in drivers, and has also led to the development of a code of hand and horn road signalling, amongst drivers themselves, which tends towards increased security on roads.

The report then summarises the laws at present in force with regard to the construction and operation of railway level crossings in the countries it covers, and of the methods of protection in use at the present time.

In his general observations at the end of the report, Mr. Newlands remarks that in view of the extent to which motor drivers and their cars pass from one country to another to-day, it may be well worth considering whether a uniform system of level crossing protection, common to all countries, should not be adopted; but, obviously, in any such consideration, regard would have to be given to the elimination of the diverse practices in certain countries where, in some cases, cars pass on the right-hand, and, in others, on the left-hand side. To-day, there is hardly any limit to the distances which motorists adventure upon, and the advantages of common practices, not only at level crossings but in the use of the road generally, are obvious.

The report by Monsieur Baticle says that all the administrations of the railways covered by the report have endeavoured, either by new regulations or by technical arrangements, to improve the safety at level crossings and to make easier the conditions under which the road traffic crosses the railway. The experiments, however, have been carried out during too recent a period and have been applied to cases frequently too limited, for any general opinion to be drawn from them as yet.

The inquiries show that in all countries the regulations concerning level crossings are issued by the State which concedes the railway and operates the road system. In the case of some nations those regulations are old, and, owing to their rigidity, interfere with the modernisation of the methods for securing safety at level crossings. Frequently, attempts have been made to prevent this by modifications in the regulations, but the result is a large number of rules which do not always simplify the question. It is, therefore, desirable that all Governments should regulate the position of level crossings by a single and clear text, as the Federal Ordinance does in the case of the Swiss Railways. These regulations should, moreover, be flexible so that the best conditions might be applied in each particular case; they should not distinguish more than two classes of level crossings—crossings with, and crossings without, keepers.

The conclusions arrived at by Monsieur Baticle are that it appears possible to conciliate the existence of level crossings with the requirements of modern traffic by means of a suitable system of signals and regulations. Moving gates, seeing that they apply to the whole of road users, should be considered as the most efficient signal. But in certain cases, where conditions as regards visibility, the railway traffic, and the road traffic allow it, they may be replaced by another system of protection—fixed, or, rather, permanent—or in some cases by approach signals.

There would then be two classes of level crossings:—(1) Supervised level crossings, *i.e.*, with gates, and (2) level crossings without keepers. As a rule, good visibility is required for the latter, and if there is little railway and road traffic the road users should be made aware of the presence of these level crossings by a position signal and a warning signal, both visible by night as by day. The trains should whistle when approaching such level crossings.

The final summary of the report by Mr. Miszke contains a statement which merits the attention of all road authorities. It is: "Whilst, in the age of slow-moving road traffic the level crossing was the most dangerous part of the road, statistics relating to the growing motor traffic demonstrate that accidents at crossings, constitute, in fact, only a small percentage of all accidents on roads."

In principle, the abolition of level crossings by the construction of over or under-bridges cannot be taken into consideration as a more or less general rule, on account of the exorbitant expenditure which it necessitates. As the increase of the difficulties at crossings has been provoked by the activity, hitherto unknown, of the road traffic, it is the road which ought to assume the costs of the construction of such bridges, as well as those for the increased protection of the crossings, necessitated by the development of road transport.

From the point of general economy and taking into account the considerable costs, an endeavour should be made to reduce, so far as possible, the number of crossings of roads and railways, by abolishing little-frequented crossings and diverting the traffic to those, which, having a more accentuated road traffic, are equipped with an adequate signalling system and by constructing over- or under-bridges at places where the maximum concentration of road traffic is to be found. In elaborating schemes for the construction or reconstruction of roads, these facts must be given due weight.

It must be recognised that at crossings where visibility is good, fixed signals can, in general, suffice, and that if the visibility is defective, the best means of protecting the crossing would be the automatic signalling of the approach of the train by the use of flashlights. At unsupervised crossings, clearly visible or possessing an automatic signalling equipment, the speed of road traffic ought to be limited. At crossings of insufficient visibility or without automatic signalling, the stopping of vehicles ought to be compulsory. In both cases these arrangements ought to be brought to the notice of the public by appropriate notices on the signals.

MECHANICAL TRACK MAINTENANCE.

Question II. is "The use of mechanical appliances in the permanent way maintenance and in track relaying." The three reporters are Mr. F. M. Thomson, of the Missouri-Kansas-Texas Lines, for the United States, the British Empire, China, and Japan; Mr. Mendizabal Fernandez, of the Madrid, Sarogosse and Alicante Railway, and Mr. Garcia Garin, of the Northern Railway of Spain; and Mohamed Kamal El Khishin Bey, of the Egyptian State Railways.

Mr. Thomson says, as regards American railways, that the class of work done by mechanical appliances, as a rule compares favourably with that done by hand labour; often it is of a better grade and more lasting. In order to keep pace with the greater speed and heavier traffic requirements the railways have improved their maintenance standards by adopting heavier and better materials in their track construction. That has promoted a tendency towards the further use of mechanical appliances in order to facilitate the work, as well as to save labour costs.

These improvements in standard practices and construction materials, with the resulting use of more mechanical appliances, has developed a recent tendency on certain large railways towards a change in gang organisation. The development has been on

certain railways towards a smaller local section force and an increase in the work done by extra and floating gangs. The amount of labour required for adequate maintenance of the track and roadway has been reduced through these developments in maintenance of way practices; and, as a consequence, heavy routine work, formerly performed by the section gangs, permanently stationed and assigned to comparatively short territories, has been transferred to specialised floating gangs, properly equipped with modern labour-saving appliances, with large resulting economies.

The list of the more important mechanical appliances which have been developed during recent years include such equipment and devices as motor cars, ditchers, spreaders and shapers, cranes and hoists—of both locomotive and crawler type—motor trucks, tie (sleeper) tampers, ballast cleaners, track mowers, weed burners, chemical weed killers, rail-laying machines, tie adzers, spike drivers, spike pullers, bolt tighteners, joint bevelling machines, &c.

In Great Britain mechanical appliances are used only to a very small extent, partly experimental. The machines used have enabled the work to be carried out more expeditiously, with a saving in cost. The extent of saving is difficult to assess; but in the case of the building-up of worn crossings that can be done at about one-fifth of the cost of replacing them, and there are good grounds for anticipating a further life, after the crossing is built up, approaching that of the previous life of the crossing. The use of mechanical tools has not been developed to such an extent as to justify the establishment of a special organisation for the maintenance of the permanent way by such means.

The summary to the report by Messrs. Fernandez and Garin says that in spite of the number of years which have passed since a start was made in applying mechanised processes to the maintenance and renewal of the track, results have not yet been obtained of such a nature as definitely to encourage their use. It is difficult to account for this. It is not known whether the cause is imperfection of the machines or tools used or insufficient experience. The use of an insufficient proportion of these machines suggests that the cause is the high first cost of the complete equipment. The number of administrations that have definitely adopted mechanical methods for the maintenance of the track is very restricted. Moreover, the time which has since elapsed is so short that one cannot appreciate whether the results obtained are really representative. There is every reason to hope that if a similar subject is taken up by technical publications and reintroduced at the next Congress, a greater quantity of information will be furnished in order to enable a definite judgment to be formulated.

A matter of interest from Germany, reported by Mohamed Kamal El Khishin, is that the consolidation of earth in new filling is done by rollers of 12 H.P. worked by crude oil or benzol. The rollers are three-wheeled, and weigh from 5 to 6 tons. It is recommended that the ballast should not be compressed more than 20 per cent., in order to maintain its elasticity.

Mechanical appliances in the countries reported upon are being used more and more for the following operations:—(1) Transportation of ballast by special self-discharging wagons; (2) tightening and untightening screws and fish-bolt nuts; (3) packing ballast under sleepers. The advantages gained, from an economic point of view, are considerable, reaching 50 per cent. if used in renewing lines or in ordinary maintenance work, provided the machines are used for a long period and systematically.

Germany does nearly all her work mechanically, and also kills weeds chemically. The reporter believes that it is most likely due to the great cheapness of hand labour that mechanical appliances do not make headway in many countries, especially in the East. During the present prevailing financial crisis some Governments have recommended the employment of hand labour as much as possible in order to relieve unemployment and for internal economy.

High Speeds and Safety.

Question III. covers "the relationship between the vehicle and the track, to ensure safety at high speeds." The three reporters thereon are:—Drs. S. Matsunawa, S. Kurokochi, and K. Asakura, of the Japanese Government Railways, for America, the British Empire, China, and Japan; Dr.-Ing. Hynek Deyl, of the Czechoslovakian Ministry of Railways, for Belgium, France, Italy, and their Colonies, Luxemburg, Czechoslovakia, Poland, Bulgaria, Roumania, Greece, Turkey, Egypt, and Yugoslavia; and Herr Professor H. Baumann and Herr F. Jöhn, of the German State Railways, for the other countries not covered by Reports I. and II. All three reports are full of statistical data presented in tabular form and accompanied by mathematical calculations. They are therefore difficult to summarise.

The Japanese reporters say that the locomotive for high-speed service is of 4–6–2 or "Pacific" type, and on some lines, where extremely large boiler capacity is required, the 4–6–4 is used. The guiding action of the two-axle leading bogie is far better than that of the single-axle truck and is especially suitable for the high-speed locomotive. There are several kinds of controlling devices of the leading truck, but that which exerts constant controlling force is preferable and seems to be favoured more and more.

Three pairs of driving wheels seem to be sufficient as far as express trains are concerned. There may be railways where four pairs are required for high-speed train service. But in such a case the diameter is kept within certain limits so that the boiler may not be excessively long. The three-cylinder or four-cylinder arrangement is recommended for smooth running of the locomotives, but such arrangements are not yet widely in use, owing to the rather complicated construction.

It is a common practice to take into account the axle load and wheel spacing in the calculations for bridges, but not in that of track, but their effect upon the strength of track is being investigated by some railways. The wheel spacing of the 4–6–2 type is generally favourable for the track, so long as the axle load is not exceptionally large. It is therefore necessary to distribute properly the total weight upon the driving and carrying wheels. Thus it will be seen that the 4–6–2 locomotive, if properly designed, may be considered the best for high-speed train service from every point of view.

On the question of the track the Japanese reporters say it seems that ordinary rails weigh as many kilogrammes per metre as about 2·5 times the number of metric tons of the greatest axle load. The corresponding figure for high-class lines on the Japanese Government Railways is about three times, which has been reached by taking into account the effects of lateral pressure, as well as economic considerations. It goes without saying that the construction of the track for high-speed service must be properly consolidated. For that purpose rails of heavy section should be used and careful consideration given to sleepers, ballast, and fastenings between rail and sleeper. Generally, a good result will be obtained by fastening rails to wooden sleepers by means of tie plates and screw spikes, and laying ballast of broken stone.

Use of longer rails, as a standard, if proper measures are taken, will not only contribute much towards comfortable riding, but will also lower the cost of maintenance. According to the experience gained by the Japanese Government Railways, the cost of tamping at the rail joints amounts to some 53 per cent. of the total cost of tamping the entire track; therefore the cost of labour is much lowered by the use of longer rails. But it seems that further consideration should be given to the handling of these rails and the extra charges for them. All railways will, undoubtedly, be unanimous in admitting that fact. In this connection an extensive study has also to be made of the electric welding of rail joints.

Care should be taken, in consideration of the equipment at curves, of the minimum radius run through by rolling stock with no limits of speed for curvature, amount of cant—super-elevation—of outer rails, length of transition curve, slack or widening of gauge, length of tangent to be inserted in a reverse curve, &c.

Summing up the answers to the questions addressed to the various railway administrations, these reporters say, on those points, that where no limits are specified because of curvature the minimum radius of curve is about 600 m.—30 chains—and the maximum amount of cant—super-elevation—is about 150 mm.—6in.—for the standard-gauge railways and about 100 mm. —4in.—for the 3ft. 6in. lines.

As illustrating the difficulty of summarising the other two reports on Question III. we may say that that of Dr. Deyl fills 109 pages, which are accompanied by five folding sheets of figures, seven full pages of tables, and seven full pages of illustrations, besides innumerable smaller illustrations.

(*To be continued.*)

The Physical Society's Exhibition.

No. II.*

One of the exhibits of Everett, Edgcumbe and Co., Ltd., was a harmonic voltmeter designed to keep a check on the wave form of an electricity supply. With the advent of the "grid," with its large transformers which are often lightly loaded, an instrument of this kind is now often needed, as a departure from the sinusoidal wave form frequently occurs. The instrument (Fig. 14) consists of a precision moving iron voltmeter, tuned to the frequency of the particular harmonic it is desired to measure, such as 250 cycles in the case of the fifth harmonic. Various circuits suitable for different harmonics can be brought into action by means of a multi-way switch. The scale may be graduated either in volts or as a percentage of the R.M.S. value of the whole wave. For finding the cause of the bad wave form with a

Fig. 14—Harmonic Voltmeter

view to eliminating it, a graphic harmonic voltmeter, giving a continuous record of the value of any desired harmonic in the wave, has often proved extremely useful. The exact time at which any distortion occurs is then definitely recorded, and an investigation into the conditions at that time will usually serve to determine the cause of the trouble.

Among other instruments exhibited by Everett, Edgcumbe were time interval meters, electrical speed indicators, a radio expert's testing set, and frequency meters. Two patterns of speed indicators were shown, a railway pattern as recently supplied to the Southern Railway for its latest electric coaches and the road pattern (Fig. 15), which is being largely used on motor omnibuses. The transmitter of the latter instrument consists of a permanent magnet generator with all its windings fixed, and therefore devoid of a commutator or other sliding contacts. It is designed so that it can be screwed on to a collar projecting from the gear-box and be driven direct from one of the shafts running at a speed of about 3000 r.p.m., with a road speed of 50 miles per hour. The dimensions of the transmitter are 2⅝in. by 5¼in. A 3¼in. black dial indicator, with

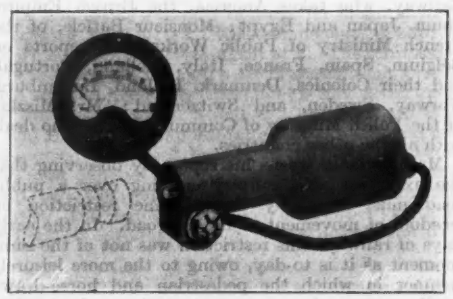


Fig. 15—Speed Indicator

white figures, has proved very convenient, but an indicator of any desired size can be supplied.

The new Griffin-Sutton bomb calorimeter, shown in Figs. 16 and 17, was one of the exhibits of Griffin and Tatlock, Ltd. The bomb consists of a stainless steel cylindrical vessel sealed at the upper and lower ends by a rubber washer inserted between a flanged cup and a screwed sleeve. At the upper end there is an inlet valve of the Schrader type, and an outlet valve for withdrawing the gaseous products of combustion, whilst the lower cup carries the crucible support and terminals for electrical ignition. The sleeves are screwed lightly in position with the fingers, thus slightly compressing the rubber washers, and the pressure of the oxygen with which the vessel is charged effectively completes the sealing.

From the inlet valve the oxygen enters the vessel between the flange of the top cap and the internal wall of the vessel. The water chamber consists of two cylindrical vessels of different diameters connected by tubes near the top and bottom, as shown in Fig. 16. In the small vessel there is a propeller stirring device, whilst the larger vessel receives the bomb. Rotation of the stirrer circulates the water through the connecting tubes and over the top and bottom of the bomb and round its walls. The water chamber stands inside a thermal shield to which pulleys are attached for rotating the stirrer.

The advantages claimed for the apparatus are:—(1) The method of sealing enables the ends of the bomb to be screwed in lightly by the fingers and to be easily removed after the pressure has been released; (2) owing to the even distribution of the incoming oxygen around the internal wall of the bomb, disturbance of the charge is avoided; (3) unusually large area of contact between the outer wall of the

* No. I. appeared January 13th.

bomb and water; (4) the clean and straight cylindrical section of the bomb avoids water pockets and facilitates cleaning; and (5) efficient stirring. A new form of pellet press supplied with the apparatus enables the ignition wire to be inserted in the sample before compression, whilst after compression the wire is firmly held in the pellet, thus reducing ignition failures to a minimum.

Silent A.C. contactors—Fig. 19—for heating, lighting, and other circuits, were exhibited by the Igranic Electric Company, Ltd. Contactor switches for 50, 100, and 200 ampères were mounted on a panel with the object of showing how readily they can be operated by thermostats, time switches, or by remote push buttons. As the magnets of the switches are only excited momentarily at the time of closing or opening, the annoying A.C. hum set up by ordinary A.C. switches is entirely eliminated. Another important advantage is that no current is consumed by the magnet whilst the motor circuit is closed. Substantial laminated brushes are provided, and are protected by renewable sparking tips, whilst shields confine the arc which is cooled by a large arc splitter. Single, double and triple-pole switches of this type are made for currents ranging from 25 to 400 ampères and for A.C. pressures up to 500 volts. Larger switches are also being designed.

The "across the line" push-button starter—Fig. 18—with thermal overload protection and designed for starting squirrel-cage motors up to 7½ horse-power, was another Igranic exhibit. The eutectic alloy thermal overload device, which may be connected in two or three phases of the motor circuit, is claimed to be the most reliable device of its kind. Starters of this type are also made with or without push buttons and without overload protection. Separate push buttons may, of course, be used, or, alternatively, the motor may be started and stopped by a pressure device, float, time switch, or other master controlling device

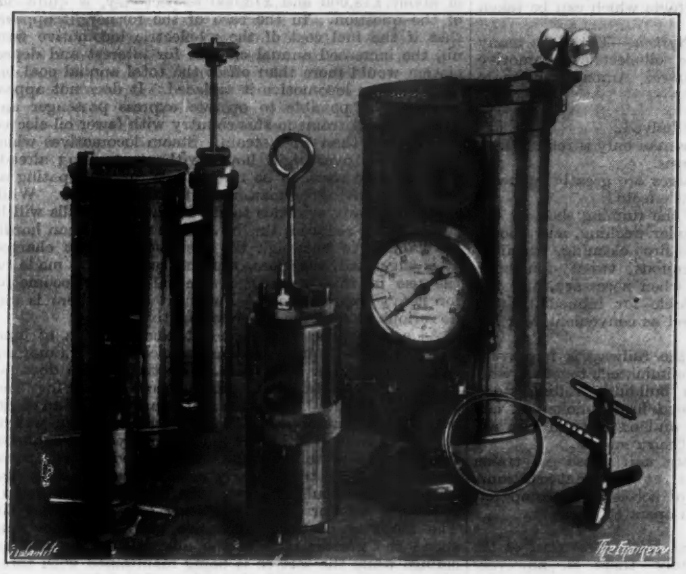


FIG. 16—CALORIMETER

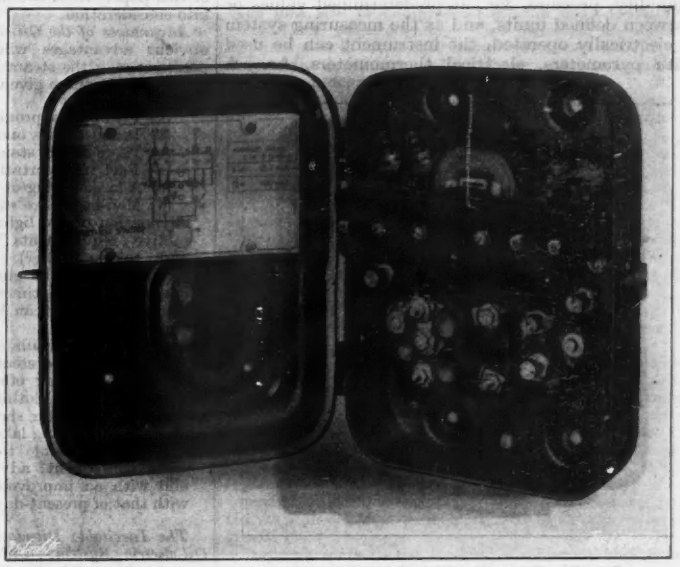


FIG. 18—PUSH BUTTON STARTER

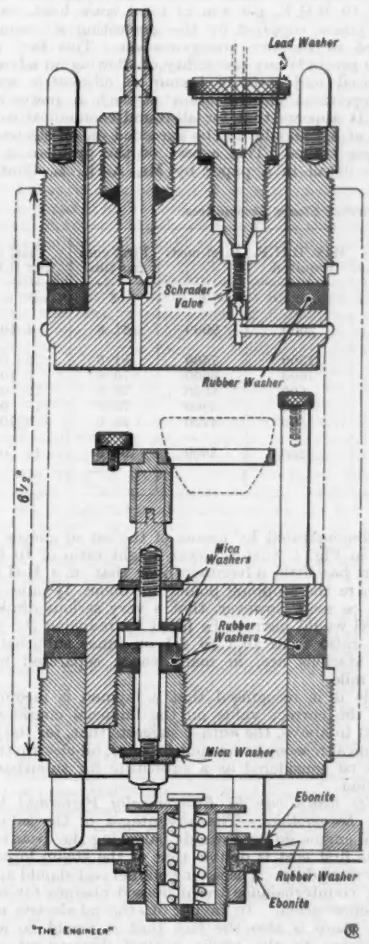


FIG. 17—SECTION THROUGH CALORIMETER BOMB

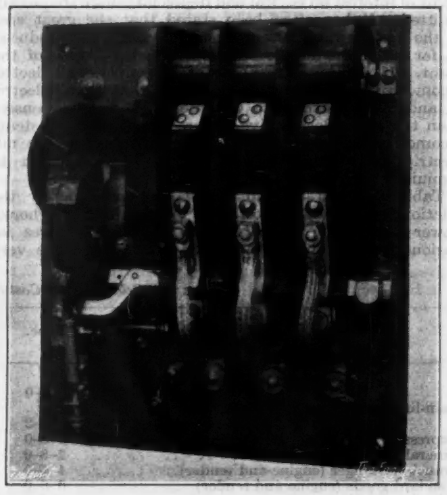


FIG. 19—CONTACTOR SWITCH

Among the many exhibits of the Cambridge Instrument Company, Ltd., was the moisture meter, shown in Fig. 20, which may be used for testing the moisture in tobacco and many other substances and depends for its action upon the fact that water has a high dielectric constant. Any material used as a dielectric will therefore affect the capacitance of a test condenser to an extent depending upon its moisture content. The meter comprises an electrical resonance circuit which includes the test condenser C and an internal condenser controlled by the dial D, a sensitive milli-ammeter MA, and a zero setting adjustment Z. The milli-ammeter is again obtained. The reading on the dial D, which is graduated from 0 deg. to 170 deg., gives a measure of the moisture content.

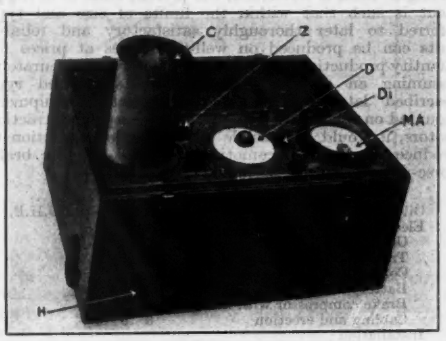


FIG. 20—MOISTURE METER

To interpret the reading in terms of moisture percentage, however, reference is usually made to a chart or graph. For each type of material a series of readings is taken for various known moisture contents obtained by the usual oven drying method and the results are plotted to give a curve relating the moisture percentage and dial reading. The curve will, of course, vary according to the material chosen, and a curve must be obtained for each material. Alternatively, as half of the dial is blank the various contents may be marked upon it in ink or pencil and the graph is then only necessary for accurate work. Extra dials can be supplied when the instrument is required to deal with more than one material, the dial shown being removable. Provided the pressure applied is not excessive, no special precautions are necessary when packing the material into the condenser C, which, when not in use, can be inserted into the housing H at the front of the instrument. For solid materials other forms of test condensers are supplied.

The power factor finder and circuit analyser shown in Fig. 21 was one of the instruments exhibited by Elliott Bros. (London), Ltd. The instrument measures the single-phase power factor of a circuit and operates as a very sensitive differential wattmeter. It consists of a sensitive detector, potentiometer, rheostat, and a small change-over switch. When measuring power factor the rheostat is adjusted until the detector does not give a deflection when the lagging or leading power factor can be read directly on the scale of the rheostat, corresponding to the position of the switch. The approximate range is from 0·35 lag to 0·1 lead, and

FIG. 21—POWER FACTOR FINDER

the indications are said to be correct irrespective of the way the leads are connected to their particular pair of terminals. In analysing the power factor of an unbalanced three-phase circuit, the power factor of each phase is measured in turn and, having noted the current, the vector relationship can be laid out. The change-over switch determines whether the current is lagging or leading.

The instrument shown in Fig. 22, which was also one of the exhibits of Elliott Bros. (London), Ltd., is an automatic regulator for controlling temperature, humidity, pressure, &c., at predetermined values or between defined limits, and as the measuring system is electrically operated, the instrument can be used with pyrometers, electrical thermometers, &c. A

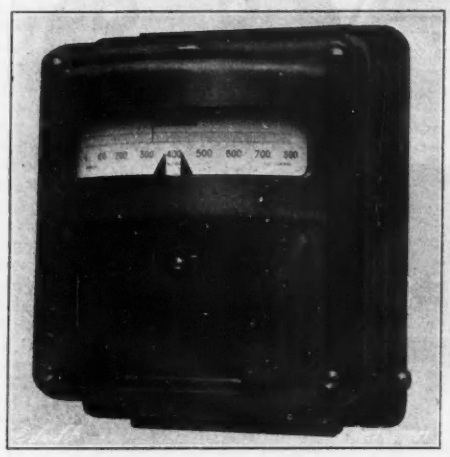


FIG. 22—TEMPERATURE CONTROLLER

chopper bar operating at adjustable time intervals causes the indictaor pointer to make and break circuits associated with contacts on adjustable limit levers.

(To be continued.)

The Compression-Ignition Engine and British Railways.*

By Lieut.-Colonel L. F. R. FELL, D.S.O., O.B.E., M.I. Mech. E

Introduction.—Much has been written recently regarding the use of the heavy-oil internal combustion engine for British railway transport. On the one hand, there are enthusiasts claiming that the internal combustion locomotive is an entirely satisfactory substitute for both the steam engine and general electrification. On the other hand, experienced railway engineers have stated that the useful application of the internal combustion engine in its present state of development is restricted to the operation of rail cars on unimportant branch lines, and that even then the system possesses disadvantages which are hardly outweighed by the advantages gained from its use.

It is hoped to show in what follows that, while the first statement is a considerable over-estimation of the economic application of the oil engine, there are now no longer any grounds for the pessimistic outlook expressed in the second statement. It is suggested that the internal combustion engine can now be applied to a British railway with a general gain in economy for certain clearly defined duties of greater importance than rail-car work only.

This paper is written from the point of view of one who is not connected with any concern building internal combustion engines for railway traction, but who has specialised for many years on the design, construction, and operation of high-speed internal combustion engines for other purposes. No significance should be attached to the fact that the author has considered that the points which he desires to emphasise are best illustrated by views of complete locomotives which are not of British origin.† The merits of the excellent examples of oil engine vehicles already developed and standardised in this country by such constructors as Messrs. Armstrong Whitworth and others, are now universally known and appreciated. It is hoped to ascertain from the discussion which is to follow whether it is possible to agree, first, that there is a future for the internal combustion engine for British railway traction, and second, what size and form of engine will best meet the requirements.

Supremacy of Electric Transmission.—Much valuable pioneer work has been done on various forms of transmission for applying the power of the somewhat inflexible internal combustion engine to railway traction. Almost every known form of transmission has at one time or another been tried. Different forms of gear drive, and hydraulic, pneumatic, and steam transmission have had much thought and good work expended on them. None of them, however, has yet shown that it is likely to equal electricity in flexibility, efficiency over a wide speed and torque range, universal adaptability, simplicity of control (especially remote control), and ease of maintenance, at lower first cost for the complete installation. While electric transmission is very expensive in itself, it makes possible the use of an oil engine running at constant high speed—that is to say, the cheapest possible type. With other systems such a low-priced engine is not adaptable. It is likely, therefore, that even were an alternative form of transmission available, the saving thus effected would be more than offset by the increased cost of the oil engine itself.

Many excellent papers have already covered fairly thoroughly the subject of non-electric transmission systems, and it is not proposed to deal with them here. Electric transmission is now standardised as regards both design and price, and hence, in examining the subject of this paper, there are definite facts which can be taken into consideration.

Advantages of the Oil-electric System.—There are many obvious advantages which the oil-electric locomotive possesses over the steam locomotive. Amongst the more important are those given below :—

(*a*) Fuel cost approximately halved.
(*b*) In most cases one engine man only is required.
(*c*) There are no standby losses.
(*d*) Fuel transportation charges are greatly reduced.
(*e*) A large saving of water is effected.
(*f*) Man-hours are saved in the running shed by the elimination of fire lighting, boiler washing, and "locomotive requirements" (*i.e.*, fire cleaning, turning, and taking water). Continuous twenty-four-hour day service can be obtained when necessary, and the engine is at all times available for immediate use. Refuelling points can be placed as conveniently as are water cranes.
(*g*) General cleanliness of the railway is improved. Smoke and waste steam are eliminated, together with their deteriorating effects on buildings, rolling stock and passengers' clothing. Dead fires, smoke-box ash and boiler scale in shed pits and on the rail side are absent, thus saving labour in their removal.
(*h*) It is possible to operate unit passenger trains with consequent advantages at terminal stations, and with an improved rate of acceleration compared with that of present-day steam-operated trains.

The Inevitable Disadvantage of High First Cost of the Oil-electric System.—Unfortunately, there is, however, one fundamental disadvantage which appears to be inseparable from the oil-electric system, and which must always seriously restrict the extent of its application in this or any other coal-producing country where water is plentiful. This disadvantage is high first cost.

It is notable in examining the various comparisons made between the running costs of internal combustion locomotives and steam engines that the all-important items of interest on capital and depreciation are frequently omitted. It has often been stated that the great cost of the various internal combustion locomotives produced so far has been due to the experimental nature of the plant. If, however, the cost of a complete oil-electric locomotive is analysed it is revealed that the oil-electric is, and must continue to be, essentially more expensive than the steam locomotive. Moreover, unlike the steam locomotive, the price per brake horse-power of the oil-electric locomotive tends to increase rather than to diminish with increasing size.

Table I. is an attempt to show approximately the relation between first cost and maximum brake horse-power required of typical British steam locomotives for various duties. Special attention is drawn to the very low first cost per brake horse-power of the high-power steam locomotive.

TABLE I.—*Relative First Cost of Typical British Steam Locomotives.*

Duty.	Type.	Weight, empty, tons.	Max. B.H.P. required.	First cost.	First cost per ton.	First cost per B.H.P.
				£	£	£ s. d.
Main-line passenger (engine and tender)	4–6–0 or 4–6–2	110	2000	9000	81·8	4 10 0
Express goods (engine and tender)	2–6–0	92	1500	7500	81·5	5 0 0
Mineral (engine and tender)	2–8–0	92	1000	6500	70·6	6 10 0
Branch passenger (engine and tender)	4–4–0	85	500	6000	70·5	12 0 0
Standard goods (engine and tender)	0–6–0	75	500	5500	73·3	11 0 0
Suburban (tank engine)	0–6–2	50	500	4750	95·0	9 10 0
Shunting or light passenger (tank engine)	0–6–0 or 0–4–4	37	250	3500	94·6	14 0 0

As stated above, the cost in production of electric transmission for the oil-electric locomotive can now be predetermined with considerable accuracy. So far as the oil engine itself is concerned, the present state of development is such that within the limits of size and type referred to later thoroughly satisfactory and reliable units can be produced on well-tried lines at prices for quantity production which can be forecast very accurately. Assuming an oil-engine unit of the specialised type described later and standardised electric equipment mounted on the locomotive, using nose-suspended traction motors, it would be possible in reasonable production to produce oil-electric locomotives for £13 10s. per brake horse-power. This cost is made up as follows :—

	£ s. d.	
Oil-engine unit	2 10 0	per B.H.P.
Electric equipment :		
Generator with exciter		
Traction motors		
Control gear		
Battery		
Brake compressor with motor		
Cabling and erection	8 0 0	
Installation :		
Cooling		
Exhaust system and		
Carriage heating		
Tanks		
Framing		
Wheels and axles		
Brake gear	3 0 0	,,
	£13 10 0	,,

Services to which the Oil-electric Locomotive is not Applicable.—Based on the above figures the first cost of main-line passenger and goods steam locomotives, as compared with oil-electric locomotives of the same power, would be as follows :—

	Steam.	Oil-electric.
Main-line passenger	£9,000	£27,000
Express goods	£7,500	£20,250

Actually, the comparison will be even more unfavourable to the oil-electric locomotive, as the nose-suspended traction motor is stated to be unsuitable for high speed, and a more expensive final drive would be required for high-speed work. An addition to the first cost of locomotives for main-line express passenger and goods services of about £18,000 and £13,000 respectively, is quite out of the question. In the case of the former, it appears that if the fuel cost of the oil-electric locomotive were nil, the increased annual charges for interest and depreciation would more than offset the total annual coal bill of the steam locomotive it replaced. It does not appear likely to be possible to operate express passenger and express goods trains in this country with fewer oil-electric locomotives than with steam. Steam locomotives which can run for over eight hours without stopping already exist. There seem to be no grounds for anticipating an important saving in man-hours for these duties. While there is already evidence to show that repair bills will be considerably reduced, this advantage by itself can hardly be claimed to outweigh the increased interest charges. It is suggested, therefore, that no case can be made for the use in this country of the oil-electric locomotive for heavy express work. For such duties there is still no serious rival to the steam locomotive.

As a substitute for dependent electrification of inner suburban lines requiring a dense service with high morning and evening peak loads, the oil-electric system does not appear very attractive. High acceleration for such services is essential. This means the provision of an engine of high maximum power with relation to train weight. As much as 10 B.H.P. per ton is employed on suburban dependent electric set trains. To provide such power in an oil-electric train clearly means very high first cost. Moreover, it would be necessary during "rush hours" to couple two or more generating sets into one train. The majority of these expensive generating sets must spend the greater part of the day idle in the carriage sidings while the service is being maintained with three-car trains carrying a single engine. Load factors would, therefore, be uneconomically low. Maintenance charges would clearly be greater for the oil-electric than for the dependent electric trains. It would be necessary to allow for a higher rate of depreciation of the oil-electric generating sets than for dependent electric track and sub-station equipment. The oil-electric generating set, together with its battery, cooling plant, exhaust system, tanks, fuel, water, and other accessories, weighs about 100 lb. per B.H.P.—that is to say, the power plant delivers to the traction motors about 20 B.H.P. for each ton of its weight. It will be seen, therefore, that in a suburban service calling for traction equipment at the rate of 10 B.H.P. per ton of total train load, one-half of the power supplied by the generating set would be absorbed in its own transportation. This fact would seem to preclude any possibility of showing an advantage in reduced fuel costs in favour of oil-electric traction over dependent electrification at such a power-weight ratio. It appears that for all-round economical working a ratio of 4/1 should not be exceeded on oil-electric unit passenger trains. This aspect of the problem is dealt with in detail in a paper by Mr. A. E. L. Chorlton.‡

It is demonstrated by means of the set of curves reproduced in Fig. 1, that a power-weight ratio of 10 B.H.P. per ton has little advantage over that of 4 B.H.P. per ton where the stopping points are about 3½ miles apart. It will be seen, however, that a very serious diminution of speed would have to be faced by reducing the power-weight ratio from 10/1 to 4/1 on inner suburban lines where stations are, in many cases, separated by less than 1 mile.

While it is recognised that a layman is incompetent to set the correct value on the financial considerations referred to above, the author suggests that, for the purely mechanical reasons he has put forward, oil-electric traction cannot be considered as a substitute for suburban electrification.

Duties which can be Economically Performed by Oil-electric Locomotives.—The advantages of the oil-electric mineral engine go far towards balancing the disadvantage that its first cost is double that of the steam locomotive for the same duty. The saving on fuel cost should approximately counterbalance the increased charges for interest and depreciation. In favour of the oil-electric mineral engine there is also the fact that it would be a great convenience to the traffic control department and in colliery yards to have an engine which could be worked all day without a break to clean the fires or take water. It should be quite safe to operate such a locomotive with one man as is normal with electric locomotives for such services abroad.

As the motive power for passenger trains on lines where the normal train does not exceed about 150 tons in weight, and a speed on the level of 60 m.p.h. can be taken as a maximum, the balance of advantage appears to be very heavily in favour of oil-electric traction. While it will be seen that first cost is but little increased, the full list

* The Institution of Mechanical Engineers.—Abstract.

† The examples described by the author have, for the most part, already been illustrated in our columns. See, for example, "Recent Progress of the Oil Locomotive," December 23rd, 1932; "Oil-electric Locomotives," November 25th, 1932; "Oil-electric Rail Cars for India," October 14th, 1932; and "An Oil-electric Shunting Locomotive," June 17th, 1932.—ED. THE E.

‡ "Proc.," Inst. C.E., 1929–30, Vol. 229, p. 197.

of advantages given above is obtainable. A goods locomotive using the same oil-engine generating set as for passenger working would appear also to be an economic proposition, the first cost exceeding that of a standard 0–6–0 steam locomotive by about 25 per cent. only. In both these cases it will be remembered that not only are fuel costs halved, but the engines can be operated by one man.

For shunting work the oil-electric locomotive would also appear to offer the advantages of economy in fuel cost and man-power without increase in first cost. On portions of a railway system otherwise given over to oil-engine working, doubtless it would be expedient that the shunting engines should be of the same type. In many cases the proximity of shunting yards to dwelling-houses would render the absence of smoke and steam a specially important advantage of the oil-electric engine.

For all the services referred to in this section, experience has already shown that the introduction of the oil-electric system will result in a large reduction in the number of locomotives necessary to operate a given service. While

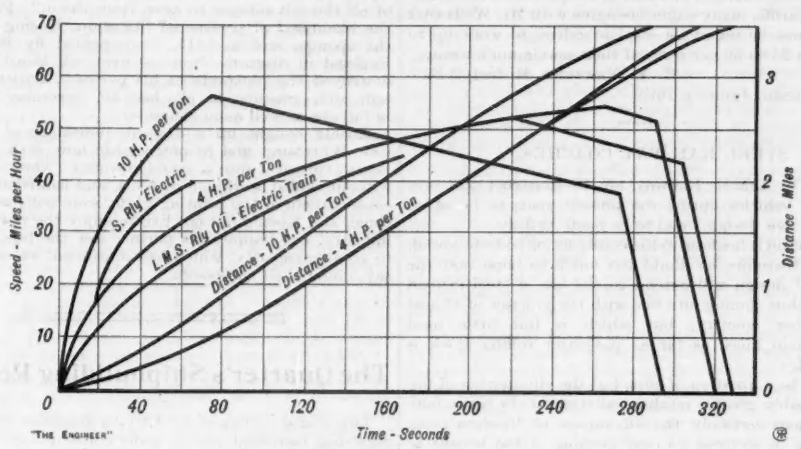

Speed - Miles per Hour
Distance - Miles
Time - Seconds
10 H.P. per Ton
S. Rly Electric
4 H.P. per Ton
L.M.S. Rly Oil - Electric Train
Distance - 10 H.P. per Ton
Distance - 4 H.P. per Ton
"THE ENGINEER"

FIG. 1—SPEED - TIME CHARACTERISTICS

this is valuable it must not be overlooked that the increased mileage per locomotive per annum would result in a higher rate of depreciation for the oil locomotive than for the steam.

Railway Oil Engine a Specialised High-speed Type.—In the foregoing stress has been laid on the vital necessity of keeping first cost at a minimum, and a figure of £2 10s. per B.H.P. has been taken for the engine itself. This low price is only possible provided the engine is of the high-speed type wth a crank shaft speed of about 1500 r.p.m. This high speed also helps to keep the cost of the generator at the lowest possible figure. The question of the first cost of high-speed engines is admirably dealt with by Ricardo in the Howard Lectures of 1931. He finds that, assuming similar type and materials and equal design efficiency, "the weight per brake horse-power is inversely proportional to the speed of revolution regardless of the size of the unit or of the piston speed." If it is assumed that the cost per unit of weight remains constant, the advantages of high speed thus appear to be very great. It is not, however, entirely correct to do this as in construction the ratio of weight of raw material to finished product becomes less favourable with reduced size. Closer limits and better workmanship are also called for on the smaller engine. While there is as yet little data available regarding the cost in production of high-speed internal combustion engines working with heavy oil on the compression-ignition cycle, there is abundant information at hand relating to production cost of similar engines operating on petrol with electric ignition. As there are no fundamental constructional differences between engines operating on petrol or heavy oil—in fact, several successul conversions of existing petrol engines to heavy-oil operation have actually been made—it is quite safe to accept the figures relating to the former as being applicable to the latter. The curve given in Fig. 2 will be found to present an approximate statement of the fall in first cost per brake horse-power with increase in number of revolutions per minute. This curve makes it clear from the outset that the large-cylinder high-power engine has no future for British railway work, its inevitable slow speed resulting in prohibitive first cost.

While high speed certainly limits the size of cylinder, and, consequently, the maximum brake horse-power which it is possible to obtain from a single engine with a reasonable number of cylinders, it is otherwise advantageous. The moderate speed type of engine with a crank shaft speed of about 750 r.p.m., having a small number of relatively large cylinders arranged in line, is by no means a simple or cheap one to construct. The crank shaft must be a large and costly forging of high-grade material to withstand the heavy impulses. The crank case presents difficulties in design owing to the heavy alternating stresses, and is, therefore, generally made in steel. Valves, owing to their size, require special treatment, and valve-operating mechanism is troublesome. To obtain adequate bearing areas for main and big-end bearings is always a problem in engines of this type. The larger the working parts, the greater is the difficulty in obtaining silence in operation. Piston clearances must increase with diameter, and the operation of large valves against strong springs is attended by a certain amount of clatter. Another defect, and probably the most serious cause of discomfort to passengers, is the heavy torque recoil from the large-bore engine with few cylinders. There is no known way of damping this out. Exhaust silencing of an engine of this type is also a very difficult problem. The reason for the present-day popularity of the moderate-speed engine is that it is only within the last three or four years that it has been demonstrated that it is possible to obtain sufficient space for fuel sprays in cylinders of less than about 8in. bore. Satisfactory operation has now been obtained from cylinders as small as 3½in. bore, and at speeds well over 2000 r.p.m

It will be clear that all the troubles referred to above as belonging to the medium-speed, large-bore engine of few cylinders are greatly reduced in the multi-cylinder, small bore, high-speed engine. The question at once arises as to whether this high-speed engine will be as durable as the one running at a lower number of crank shaft revolutions per minute. The answer to this is that it is, generally speaking, possible to design the small, high-speed engine with lower bearing factors than is convenient with the larger engine. The rate of removal of material by wear on the high-speed is, therefore, lower than on the medium-speed engine. As, however, a smaller dimensional alteration can be tolerated on the high-speed engine than is admissible on the engine running at lower speed, the net result is that there is little or no difference between the two types in periods between overhauls. In this connection it is perhaps not without interest to state that twelve-cylinder petrol water-cooled aircraft engines of about 500 B.H.P. weighing less than 1¼ lb. per rated B.H.P., and running most of the time at, or above, 60 per cent. full load at 2200 r.p.m., now run regularly for 500 hours between overhauls, and this period can be extended to 600 hours. With the increase in bearing surfaces and lower stressing which would be possible in the design of a high-speed engine for railway work, in which weight would not be an important consideration, it seems likely that periods between overhauls could be secured which would considerably exceed that of present-day steam locomotives.

In the foregoing it has been shown that for powers above 1000 B.H.P., the oil-electric system cannot compete with the steam engine.

Referring to Table I., it will be seen that for all the duties which the author claims can be economically carried out by the oil-electric locmotive, two sizes of engine will suffice—namely, 250 B.H.P. and 500 B.H.P. For the mineral locomotive two engines of the latter size would be employed. For medium passenger and goods locomotive one 500 B.H.P. unit would be correct, while the 250 B.H.P. unit would be sufficient for light passenger (rail car) or shunting locomotives. These two sizes of engines can be built up of one standard cylinder of the following dimensions :—

Cylinder bore : 6¾in.
Cylinder stroke : 8in.
Speed of revolution : 1500 r.p.m.
Brake horse-power : 42.
Brake mean effective pressure : 85.
250 B.H.P.: Six cylinders in line.

‡ 500 B.H.P.: Twelve cylinders driving a six-throw crank, cylinders arranged in two banks of six at 60 deg. The close standardisation suggested above is essential in order to obtain a sufficiently large output to enable

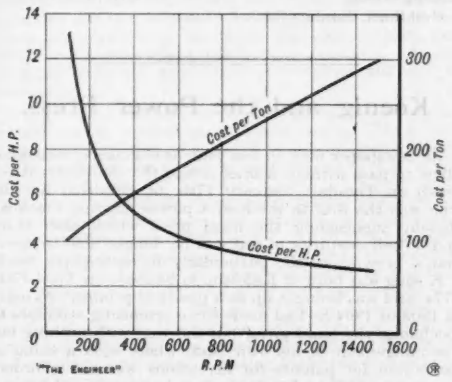


FIG. 2—FIRST COST AND SPEED

the price of £2 10s. per B.H.P. to be achieved. Also, the advantages to be derived from standardisation in the supply of spares and training of workmen are obvious. It has been stated elsewhere that different types of internal combustion engines should be used for dealing with the various classes of traffic. There does not, however, appear to be any justification for this practice, seeing that the duties of the internal combustion engine are precisely the same in all classes of locomotives, namely, to drive an electric generator. The generating set is obviously unaffected whether the current is used to drive a high or low-geared traction motor. Provided, therefore, that adequate preliminary development work is done on all parts of the engine unit before production is commenced, there are no disadvantages and many important advantages of complete standardisation for each individual railway system, in the same way as certain road transport companies have already standardised engines working on the compression-ignition cycle.

Conclusion.—As explained at the outset, the object of the paper is solely to draw the attention of locomotive engineers to what can actually be achieved at the present time by the internal combustion engineer, and thus to aid the British railways in coming to a decision as to what type and size of compression-ignition engine will best meet their requirements. This decision is urgently required now in order that future effort may be expended only on the development of useful types of railway internal combustion engines.

The specialised railway internal combustion engine and installation suggested in this paper cannot be brought to the stage where standardisation is economical until a considerable amount of methodical experimental development work has been carried out, first, on the engine itself, and later on the complete installation, so as to discover and eliminate all possible sources of unreliability. The author suggests that to ensure that this necessary preliminary work is put in hand is a matter of first-class urgency for the British railway companies. As a century ago it was necessary to develop the existing steam engine into a specialised form to meet railway requirements, so must the internal combustion engine of to-day be developed independently of marine and stationary practice to suit the special demands of railway service.

The author has attempted to show the extent to which the high-speed internal combustion engine can assist the railways at the *present* time in their efforts to regain the prosperity which he firmly believes is only lost to them temporarily. Rail transport has still by far the highest mechanical efficiency of any system of transport yet discovered. As proof of this it should be noted that it is now usual in this country to provide engines of ten times the horse-power to move a given load by road than is found necessary on the railway at the same average speed.

Improvements in the internal combustion engine and a lavish expenditure of public money on road construction during recent years have led to an increase of speed, and, in consequence, an increase in volume, of road transport. It is now generally recognised that this expansion has been obtained at the expense of safety. No improvements in vehicles which the engineer can make are likely to effect a reduction in the number of road accidents. Safety on the road depends, and always must depend, on the ability and care of individual road users. This fact, therefore, sets a definite limit to the extent to which the development of road transport is in the interests of the community. On the other hand, the whole trend of development in modern railway practice is to eliminate the human element. So far as safety is concerned, there seems to be no reason why rail speeds should not be advanced on British main lines almost to that of present-day commercial aircraft, though at only a fraction of the cost of operation of air transport. Average speeds of 80 to 90 m.p.h. are, for many reasons, uneconomical with existing steam locomotives and rolling stock. It is possible to visualise in the *future*, however, the oil-electric system applied to a design of car embodying the latest knowledge regarding light-weight construction, suspension, and streamlining, which would be able to achieve speeds of the order mentioned above. The German experimental train already mentioned is designed with this end in view. Should this experiment prove to be successful, the compression-ignition internal combustion engine may thus prove to be the means of ushering in a new era of railway transport both for the conveyance of passengers and possibly even certain classes of goods.

‡ A Maybach twelve-cylinder V-type compression-ignition engine giving 410 B.H.P. at 1400 r.p.m. is employed on the high-speed streamlined rail car for the German National Railway.

PRODUCTION OF IRON AND STEEL IN 1932.

THE monthly returns of the National Federation of Iron and Steel Manufacturers show that in the last month of 1932 there were sixty furnaces in blast, or one more than at the beginning of the month. Four furnaces commenced operations and three were blown out during the month. Production of pig iron in December amounted to 284,500 tons, compared with 267,700 tons in November, and 330,600 tons in December, 1931. The production included 76,600 tons of hematite; 123,600 tons of basic, 68,000 tons of foundry, and 10,600 tons of forge pig iron.

The output of steel ingots and castings amounted to 430,400 tons, compared with 473,800 tons in November and 425,400 tons in December, 1931.

The December figures bring the total pig iron output for the year to 3,573,000 tons, compared with 3,772,600 tons in 1931 and 6,192,400 tons in 1930; and of steel to 5,256,800 tons, compared with 5,202,600 tons in 1931 and 7,325,700 tons in 1930.

The following table shows the average monthly production of pig iron and steel ingots and castings in 1913, 1920 and 1929 to 1931, and the production in each month since December, 1931 :—

		Pig iron. Tons.	Steel ingots and castings. Tons.
1913	Monthly average	855,000	638,600
1920	,, ,,	669,500	755,600
1929	,, ,,	632,400	803,000
1930	,, ,,	516,000	610,500
1931	,, ,,	314,400	433,500
	December	330,600	425,400
1932	January	330,000	429,700
	February	323,600	480,600
	March	335,600	462,800
	April	316,800	433,300
	May	315,300	416,900
	June	311,400	459,300
	July	292,600	438,400
	August	259,400	361,500
	September	260,400	430,300
	October	275,600	439,800
	November	267,700	473,800
	December	284,500	430,400

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents).

OIL-ELECTRIC LOCOMOTIVES.

SIR,—In Lt.-Col. Fell's very interesting paper on "The Compression-ignition Engine and its Applicability to British Railway Traction," which was read last Friday before the Institution of Mechanical Engineers, it is stated that on suburban electric trains a common allowance of power is 10 B.H.P. per ton of total train weight. It is further stated that an oil-electric generating set including the battery, cooling plant, exhaust system, tanks, fuel, water, and other accessories weighs about 100 lb. per B.H.P.—that is to say, the power plant delivers to the traction motors about 20 B.H.P. per ton of its weight. From these data Col. Fell concludes that if an oil-electric locomotive is designed to provide a train with power on the same scale as a suburban electric train, namely, 10 B.H.P. per ton of total train weight, the power plant would expend half its total output simply in transporting its own weight.

During the discussion no one, I noticed, called attention to the implication of Col. Fell's figures. They really, however, fix a ratio between the weight of the power plant and the weight of the train. Thus let W_1 be the weight of the power plant as specified by Col. Fell, let W_2 be the weight of the locomotive carcase minus the power plant, and W_3 be the weight of the coaches attached to the locomotive. Then the total train weight is $W = W_1 + W_2 + W_3$. At 10 B.H.P. per ton of total weight the power allowance is 10 W, while at 20 B.H.P. per ton the power plant will deliver to the traction motors 20 W_1. These two power values are equal. Hence we have

$$20\,W_1 = 10\,W = 10\,W_1 + 10\,W_2 + 10\,W_3;$$

that is $10\,W_1 = 10\,W_2 + 10\,W_3$,

or $W_1 = W_2 + W_3$.

In other words, the weight of the power plant is equal to the combined weight of the locomotive carcase and the coaches or, put otherwise, the power plant accounts for exactly half of the total weight of the train.

Is this deduction justifiable, and, if it is, is it reasonable? A steam locomotive weighing with its tender 100 tons can easily handle a train of vehicles weighing 300 tons. Even if we ascribe the whole of the 100 tons to the equivalent of the power plant, that is to say, if we take the weight of the carcase of the locomotive at zero, the weight of the power plant will be only one-quarter of the total train weight. Comparison may also be made with a motor car. What would we think of a 20 H.P. car which spent half its power simply on moving its own engine and had only 10 H.P. available for transporting its body and its driver and passengers?

I submit these comments to you because more than one speaker in the discussion contended that the weight of the engine of an oil-electric locomotive was not of great importance. It seems to me to be of very great importance, for if it were doubled, without increasing its output, it would have sufficient power to move only itself, while if it were halved, without decreasing its power, it would have an output of 40 B.H.P. per ton and would set free 50 per cent. more power for moving the carcase and coaches. On the same power allowance the train might therefore have nearly half as many coaches again added to it or alternatively the output of the engine and its associated equipment might be reduced by one-third. C. T. A.

January 16th.

UNEMPLOYMENT OF PROFESSIONAL ENGINEERS.

SIR,—I regret that, by a misprint, you gave the signature "S.M.I. Mech. E." to my letter on "Unemployment and the Professional Engineer," in your issue of January 13th. This rather detracts from its weights, as it makes it appear to be the view of one who has just been disillusioned. Actually, I was not speaking for myself, as I have been comparatively very fortunate, but I do feel that the profession as a whole has a responsibility towards the inexperienced and the less lucky. Very many of us, from time to time, must have forcible reminders of the large numbers who are in search, either of any employment at all, or of less miserably paid employment. On such occasions I have an uncomfortable feeling that our profession is rather neglectful. A.M.I. MECH. E.

January 16th.

STEEL FOUNDRIES AND FABRICATION.

SIR,—The "Idle Thoughts of a Busy Engineer," by Mr. G. E. Wells, in your current issue, show a pessimistic attitude of mind, although his observations are unfortunately true in some respects. His suggestion that compensation should be paid to those firms who should be compelled to close their doors is not likely to meet with the approval of those who have installed up-to-date plants or perhaps have developed a speciality. The British mind is conservative, as is shown by its inability to adapt itself to changed conditions, and its reluctance to co-operate with other firms in order that each may specialise on productions most suitable for their respective works, in which case each firm would produce only those articles that could be turned out efficiently and economically. During a recent visit to Canada and the U.S.A. I was impressed by the fact that steel foundries are almost a thing of the past, and drop forgings and stampings and general fabricated work have taken their place. Large arc welding plants are installed in all works of any magnitude and the framework of motors, generators, and turbines, large and small, and many other productions are now built up of standard steel sections, &c., and welded into the desired shapes. Their finished appearance may not perhaps satisfy an æsthetic eye for beauty of curves and streamlines, but for efficiency and cheapness this method of construction cannot be surpassed. There are many foundries in England eminently suitable for this class of work, and my object in penning this letter is to suggest to directors of steel foundries that changed methods are required, for, notwithstanding tariffs, many engineers agree with Mr. Wells that work cannot be found for steel foundries to work up to more than 25 to 30 per cent. of their maximum output.

H. E. YERBURY, M. Inst. C.E.

Maidenhead, January 16th.

STEEL RAILWAY COACHES.

SIR,—The L.N.E. Railway are to construct 278 new passenger vehicles during the present year, to be of an "entirely new design," and to be ready in July.

No mention is made as to the construction to be followed, and it is therefore no doubt too much to hope that the novelty of design will extend to the use of steel instead of wood, thus coming into line with the practice of almost every other country, but which is but little used on our main lines, as far as passenger rolling stock is concerned.

It may be a question of cost, but the elimination of fire risks, possibly greater mechanical strength to resist telescoping, and certainly the advantage of freedom from splintering in accidents, to say nothing of the benefit to our steel industry, would seem sufficient reasons to tip the balance in favour of steel construction. F. N. B.

London, January 14th.

MUNICIPALITIES AND FOREIGN CONTRACTS.

SIR,—I am glad to read in Friday's THE ENGINEER what Mr. George Mitcheson has to say about the situation between this country and U.S.A. It is my own opinion and that of very many others that we are justified in considering whether we should continue to support American industry both by buying goods imported from the States and by accepting as "British made" the products of American organisations now based in this country. Although they may be described as "Made in Britain," goods of American raw material, produced by Yankee methods and providing profits for the United States, are clearly not British goods.

The consumer should remember that distinction to-day.

J. O'D. SINCLAIR (Lt.-Col.).

London, January 14th.

EGYPTIAN LOCOMOTIVE OF 1859.

SIR,—There is a slight mistake in M. Wiener's beautiful book on the Egyptian railways, to which attention was not drawn in your review, but which is, I think, sufficiently important to correct, namely, that the saloon engine illustrated in colours (Fig. 14) is the one built in 1859, not 1862, as stated. The engine of the latter year (Warren, page 411) had outside cylinders, and a still more Oriental-looking saloon. C. F. DENDY MARSHALL.

Guildford, January 14th.

Koenig and the Power Press.

As newspaper men no less than as engineers, we cannot allow to pass without a brief notice the centenary of the death on Tuesday, January 17th, of Friedrich Koenig, who was the first to produce a power printing machine, thereby superseding the hand press which after three and a half centuries of use was no longer able to serve man's growing needs, particularly for newspaper work.

Koenig was born at Eisleben, in Saxony, on April 17th, 1774, and was brought up as a practical printer. As early as 1803 or 1804 he had made some promising attempts to mechanise the hand press, but meeting with nothing but discouragement in his own land, where such a thing as protection for patents for inventions was not afforded, he came in 1806 to London, where he maintained himself by working at his trade, meanwhile continuing his attempts to improve the hand press. He made the acquaintance of Thomas Bensley, a well-known master printer, and of Robert Taylor, editor of the *Philosophical Magazine*, who became partners with him. Thus encouraged, Koenig was enabled in 1810 to take out his first patent. This was for a platen machine embodying inking rollers, but was not a success. His next patent in the following year embodied the cylinder with tapes to hold the sheet of paper, duct and rollers to distribute the ink, and the reciprocating flat bed for the forme—essentially, in fact, the modern machine. Koenig was most fortunate in the collaboration of a fellow-countryman, Andreas Friedrich Bauer (1783–1860), an instrument maker, who had come to England about the same time as Koenig. In 1811 he joined Koenig to take charge of a workshop that the partners set up in Whitecross-street. This friendship proved to be as that of David and Jonathan John Walter, of *The Times* newspaper, who, although in touch with Bensley, had hitherto stood aloof, was now so satisfied that he ordered two machines. After eighteen months' incessant toil, during which Koenig took out further patents for improvements, the editor, in the issue of November 29th, 1814, was able to make the following memorable announcement: "The reader of this paragraph now holds in his hand one of the many thousand impressions of *The Times* newspaper which were taken off last night by a mechanical apparatus. . . . No less than 1100 sheets are impressed in one hour." This was roughly five times the output of men at the hand press even with the most exhausting efforts. The machines were double, *i.e.*, there were two cylinders, each taking off impressions from one forme. It need hardly be mentioned that the journeymen printers were violently opposed to the foreigner and his machines, and that master printers were so sceptical that they would not even go and look at them.

The future now looked rosy for Koenig, but Bensley behaved most treacherously; he was found out "in laying a scheme for defrauding his partners in the patents of all the advantages to arise from them." Faced with the likelihood of protracted litigation, Koenig threw up the sponge, and in 1817, accompanied by Bauer, left England in disgust. Nemesis overtook Bensley: "He destroyed the prospects of his partners, outwitted himself, and, grasping at all, lost all, becoming bankrupt in fortune as well as in character."

Koenig bought up a disused monastery at Oberzell, near Würzburg, and in partnership now with his friend Bauer, turned it into a machine works. Their difficulties without skilled workmen or tools, and confronted by the conservatism of the printing trade, were not readily overcome, and Koenig did not live to enjoy the reward of his industry, but happily his partner saw the business grow to great prosperity, which has continued, we are glad to say, under their successors.

The Quarter's Shipbuilding Returns.

THE statistics issued by Lloyd's Register of Shipping regarding merchant vessels under construction at the end of December last show that in Great Britain and Ireland there has been a still further decrease of 12,936 tons in the work in hand, as compared with the very low figures for the previous quarter, and that the present total—225,497 tons—is 175,008 tons less than the tonnage which was being built at the end of December, 1931. Further, the figure for December, 1932, includes about 142,000 tons on which work has been suspended—127,000 tons of steamers and 15,000 tons of motor ships. The present total of 225,497 tons is the lowest ever recorded by Lloyd's Register. Nearly 80,000 tons—over 35 per cent. of the tonnage now in hand in this country—are intended for registration abroad or for sale.

The tonnage now under construction abroad—540,223 tons—is about 122,000 tons less than the work which was in hand at the end of September, 1932, and is the lowest recorded since September, 1910. Tonnage, included in this figure, on which work has been suspended amounts only to 3155 tons of steamers and 21,568 tons of motor ships. The six leading countries are:—France, 101,675 tons; Germany, 80,310 tons; Japan, 63,345 tons; United States of America, 59,628 tons; Italy, 59,113 tons; and Sweden, 58,530 tons. The total tonnage under construction in the world amounts to 765,720 tons, of which 29·4 per cent. is being built in Great Britain and Ireland and 70·6 per cent. abroad.

In Great Britain and Ireland only 7410 tons were commenced during the last three months—the lowest figures on record—and 39,403 tons were launched, this figure showing a decrease of 8481 tons as compared with the September quarter. Similar figures for abroad are 76,371 tons commenced and 173,838 tons launched, showing an increase as compared with the previous quarter of about 44,000 tons in the tonnage commenced, and of 33,500 tons in the tonnage launched.

The oil tankers under construction in the world amount to twenty-five vessels of 194,490 tons, of which four vessels of 30,026 tons are being built in Great Britain and Ireland, eight vessels of 54,000 tons in Sweden, and four of 49,600 tons in Germany. It is noteworthy that motor ships account for over 91 per cent. of the total tanker tonnage under construction, which comprises more than 25 per cent. of the total steam and motor tonnage being built in the world.

Of the 225,497 tons under construction in Great Britain and Ireland at the end of December, only 20,611 tons consisted of motor ships, while at the same date the motor ship tonnage being constructed abroad (372,138 tons) was 205,228 tons in excess of that of steamers. The vessels being built in the world at the end of December include eight motor ships of between 8000 and 10,000 tons each, two steamers and ten motor ships of between 10,000 and 20,000 tons, and four steamers and no motor ships of 20,000 tons and upwards.

The table respecting marine engines shows that the horse-power of steam engines now being built or being fitted on board amounts to about 567,000 H.P.; these figures include fifteen sets of turbine engines of about 480,000 shaft horse-power, giving an average of 31,960 H.P. per set. The horse-power of the steam reciprocating engines (about 87,000 H.P.) is less than 10 per cent. of the total horse-power of marine engines now being built in the world. The figures for oil engines aggregate about 358,000 H.P.

Although inevitably affected by the continued unprecedented reduction in the total amount of work in hand throughout the world, the tonnage being built under the inspection of Lloyd's Register at the end of December amounted to 466,838 tons, viz., 214,479 tons in Great Britain and Ireland and 252,359 tons abroad.

A NEW electric steel furnace has been installed by Sorel Steel Foundries, Ltd., at Sorel, Quebec, for the manufacture of manganese, carbon, and other alloy steels.

Railway and Road Matters.

A RAILWAY station named after a famous band is to be opened for traffic by the L.M.S. Railway on February 1st. The station is "Besses-o'-the-Barn," on the L.M.S. electrified line from Manchester to Bury, and is situated between Whitefield and Prestwich. On and after February 1st all electric trains, week-days and Sundays, for Whitefield and beyond, and from Bury (Bolton-street), Radcliffe, and Whitefield, will call at Besses-o'-th'-Barn.

THE proceedings as to railwaymen's wages before the National Wages Board have ended in complete disagreement. The announcement was made on Friday, January 13th, that six reports have been signed; they, however, represent three views. One view is that of the companies, and another represents the men, whilst included in each of these are the equally divided opinions of the "users of the railway." Finally, the independent chairman differs from the other parties.

As a matter of historical interest it may be recorded that the big South signal-box at Brighton, which, as related on page 34 of our issue of January 13th, has just been replaced, was built in 1883. Its 240 levers in one continuous frame remained the record until the 260 in Waverley East box, Edinburgh, were put into service about 1899. Later, the record passed to the 295 in the Locomotive Yard box, York. The biggest frame to-day is the 311, power operated, at London Bridge.

THE Ministry of Transport railway statistics for the calendar month of October and for the four weeks ended November 5th show that, compared with the corresponding period of 1931, there was a decrease of 3·6 per cent. in the number of passenger journeys and the receipts thereform fell by 4·5 per cent. The tonnage of goods traffic decreased by 8·6 per cent. and the goods train receipts by 11·9 per cent. The goods train mileage was brought down by 6·7 per cent., but the average train load fell from 124 to 121¼ tons. The average speed was improved, as the net ton miles per engine hour increased from 446½ to 450.

AFTER holding the position of works manager at Gorton, L. and N.E.R., for twenty-six years, Mr. J. W. Smith has just retired. He began his railway career at Gateshead in 1883 and in 1891 went to the Midland Railway at Derby, where, eventually, he became the chief draughtsman in the locomotive department. Whilst in the latter position Mr. Smith had much to do with the design of the celebrated Midland compound engines, which follow the type associated with his brother, Mr. W. M. Smith, of the North-Eastern Railway. The new works manager at Gorton is Mr. F. W. Carr, who, in turn, has been succeeded as works manager at Darlington locomotive works by Mr. L. Farr, the assistant works manager there.

IT will be one hundred years to-morrow, January 21st, since a committee, representative of the Bristol Corporation, Society of Merchant Venturers, Bristol Dock Company, Bristol Chamber of Commerce, and the Bristol and Gloucestershire Railway Company held a meeting in Bristol which led to the appointment of I. K. Brunel to make a preliminary survey and prepare an estimate for a railway between Bristol and London. The results were submitted to a public meeting at the Guildhall, Bristol, on July 30th, 1833, when it was decided to form a company. The co-operation of an influential London committee was formed, with C. A. Saunders as secretary, and at a joint meeting of both bodies in London on August 19th, 1933, it was decided to adopt the name of the Great Western Railway.

THE number of divisions in the engineer's department of the Southern Railway has been reduced from seven to six. That has been made possible by the retirement of Mr. John Shaw, who was the engineer for the eastern division, with offices at Ashford. Mr. H. E. Robarts, hitherto the engineer for the southern division and stationed at Croydon, has gone to Ashford and his position will not be filled. What has been the Portsmouth division, under Mr. C. V. Hill, at Brighton, is now re-named the southern division. Mr. Shaw was for seven years on the Manchester, Sheffield and Lincolnshire Railway, first under Mr. Thomas Parker and afterwards under Mr. Alexander Ross, and went to the South-Eastern in 1897, as an assistant to Mr. P. C. Tempest, becoming district engineer at Ashford in 1904.

AT the Institution of Railway Signal Engineers, on the evening of Wednesday, January 11th, a paper was read by Mr. W. Bryson on "The Token System on Single Lines." The provision of different tokens for each section of a line means that one must be given up and another collected at each token station, and the paper read on January 11th was descriptive of apparatus used for making the exchange of tokens by mechanical means instead of the signalman and fireman doing it by hand, which latter means often led to the men getting hurt when the train was travelling at speed. So frequent were these accidents that the Railway Safety Appliances Committee got the Board of Trade in 1907 to recommend the use of exchange apparatus or to limit the speed to 10 m.p.h. The original exchange was designed—but not patented—by James Manson, then the locomotive superintendent of the Great North of Scotland Railway, about 1890.

IN the *London and North-Eastern Railway Magazine* for January is a note by Mr. John Miller, the chief engineer of the North-Eastern area, which records that short fish-plates, with two bolt holes, have been found so satisfactory that they have been adopted for general use on that area in lieu of the standard 18in. plate. The short plates have the advantage of being little more than half the price of the standard plate. They also tend to reduce the hammer at the joint, as the joint sleepers are placed closer together. The short plate also has a very much greater resistance to fracture than the longer plate; so much so, that breakages are practically non-existent. Another interesting feature is that a considerable percentage of long plates can be utilised again instead of going on to the scrap heap. The method in that case is for the fractured long plate to be cut through the centre into two 9in. lengths, each length having two bolt holes, and the half containing the fracture is scrapped. Many thousands of cracked and broken plates have been utilised in this way in lieu of new plates, at a fraction of the cost of the latter.

Notes and Memoranda.

ONE of the various uses for radium is in the form of radio-active fertilisers, and ore residue is utilised for this purpose. Records show that by mixing this by-product with ordinary fertiliser in the ratio of about one to nine the yield of agricultural products is increased two or threefold.

AN unusual and interesting machine for removing the molten iron from the molten slag in blast-furnace or open-hearth operation has been recently developed in Pittsburg. The iron is recovered by means of centrifugal force and the slag is then granulated. The free iron is recovered in a usable form.

THE electric arc cutting saw is a recent development having, says *Machinery*, considerable possibilities. Metal bars, shapes, and similar parts can be cut by means of a rapidly rotating disc wheel through which a current of electricity flows. Among the materials used for the wheel are carbon and different forms of abrasives. The wheel forms one electrode and the work to be cut the other.

IN the *Architect* for January 6th there are some photographic illustrations of a school in Holland of which the structure is a reinforced concrete framework, almost entirely filled with glass. Commenting on the design, that journal says:—"While the design repays study, one would like to know from the staff the effects of strong sunlight, and if the noise and view of passing traffic are distracting."

POTENTIAL world supplies of boron compounds are still far ahead of consumption, and the possibility of new compounds is one, says the *Chemical Trade Journal*, that must not be lost sight of. Sodium perborate is now a highly useful industrial oxidising agent, whilst sodium metaborate, a compound of more recent introduction, has already established its own sphere of utility owing to its considerably greater solubility in water, and its higher alkalinity, than borax itself.

AN apparatus for the colorimetric determination of the phosphate content of boiler feed water has been put on the market by the Ostwald-Energie G.m.b.H., of Grossbothen i. Saale. The apparatus was devised at the request of the Vereinigung der Grosskesselbesitzer E.V., of Berlin, the members of which are adopting on an ever-increasing scale the use of trisodium phosphate for the treatment of boiler feed water. The apparatus is described in *Die Chemische Fabrik*, of January 4th, 1933.

A SIMPLE method of measuring the angle of inclination on new ships has been recently introduced in America. It dispenses with the use of pendulums and comprises a micrometer spirit level extremely sensitve and finely adjusted, and with a 10in. athwartship base scale. With the ship on even keel, this instrument is set level, and as the ship is listed the instrument is brought back to level by a series of micrometer screws. The inclination is accurately arrived at by measuring the distance through which the table of the instrument has been elevated, expressed on a base of 10in.

IT is pointed out in the latest Survey Paper of the Ministry of Mines that the Silkstone seam of South Yorkshire discloses a fuel of such high class as to deserve the greatest publicity. The seam is generally low in ash and moisture and the harder portion is justly celebrated as a house coal. The softer portions have all the most desirable properties of a coal for carbonisation either in gasworks or coke ovens. In this respect its low content of alkali chloride is advantageous in minimising the destructive action of alkali on the refractories of carbonising plant. The Paper, No. 25, may be obtained from H.M. Stationery Office, price 1s.

IN the course of a lecture on the Essentials of Good Welding, read before the Institution of Welding Engineers, Mr. A. G. Walker said that in the welding of stainless steel correct flame adjustment is extremely important. Strictly speaking, an absolutely neutral flame should be used; an excess of oxygen is particularly bad and gives unsound welds. It is usual to adjust the flame with a small but definite excess of acetylene, about ⅛in. long, or half the length of the white cone, at the end of the white cone of the flame. All stainless steel should be veed and the excess of acetylene in the flame should play upon the metal and envelope it. It should be remembered that a real excess of acetylene in the flame will produce hard and brittle welds and reduce resistance to corrosion. As the blow pipe gets hot, any excess of acetylene will tend to disappear.

PRECAUTIONS are not often taken by operators of low-voltage circuits against shock, according to "M. P. D." in the *Electrical Review*. The direct short-circuit effects can be neglected, as a rule, at voltages below 100. Condenser shocks cannot, however, be treated lightly when big capacity is available, as in electro-plating installations, for instance. In one case the operator of an electrolytic zinc refining tank was badly hurt by contact with the anode where the pressure was only 15 v. Owing to the gassing, the plates had become completely insulated by polarisation. Granular material was being used, so the area was extensive. On touching the anode, the operator received a severe shock. Such accidents are not unusual on large conductors employed in various industries. An earth connection to both poles of plating tanks can be arranged without appreciable loss of current. This will generally prevent severe capacity shocks.

IN a paper on Stress Recorders delivered on January 6th before the Junior Institution of Engineers, Mr. Gordon F. Kent described the evolution of the stress recorder in connection with the determination of the effect of impact caused by the passage of engines and other vehicles on steel bridges and similar structures. In these days of economy with efficiency the bridge engineer, he said, must not condemn a bridge on theoretical grounds alone, but retain it in service until the minimum factor of safety is reached, and it was in checking his judgment, gained by experience, as to when that factor was reached, that the stress recorder was of special service, as its increasing use indicated. By a study of the results obtained from the records of these instruments the engineer is able to advise the retention in service of structures that otherwise would have been renewed, and yet can be confident that the true factor of safety is not reduced.

Miscellanea.

A FACTORY for the manufacture of transparent paper is to be put up at Wigton in Cumberland.

THE Bloxwich route service of the Walsall municipal tramways is to be replaced by trolley omnibuses.

DURING the month of November, 1932, the number of new motor vehicles registered was 20,146, compared with 16,771 in November, 1931.

THE old granary warehouse at St. Pancras of the L.M.S. Railway has been re-equipped for the general railhead distribution of goods traffic.

DURING last year 378,923 horse-power was added to the hydro-electric development of Canada, making a total of 7,045,260 horse-power.

IT is proposed to set up a joint advisory board for consultation and concerted action in reducing the pollution of the waters of the Severn Estuary.

AN aerodrome, for use in connection with the Transatlantic mail services, is to be laid out at Atlantic Park, between Southampton and Eastleigh.

THE value of machine tool accessories and precision tools and instruments made in the United States during 1931 amounted to over 73,000,000 dollars, a decrease of 60 per cent. as compared with 1929.

WORK in connection with the irrigation project on the Volga is now in full swing. A dam is being constructed in Kamyshin to facilitate the irrigation of 11,250,000 acres of land and the development of electric power.

THE Teesta Bridge, which is being built across the river of that name, 20 miles above Sivoka, will be the largest of its kind in India. It is a single reinforced concrete span of 300ft. and is 18ft. wide. It is hoped to open it in March.

THE construction of the first hydro-electric station in Manchuria, with a capacity of 50,000 kW, is proposed by the Manchukuo Government, says *The Electrical Review*. The South Manchurian Railway Company is also contemplating the erection of a 50,000 kW thermal station for the extension of its existing undertaking.

A SUCCESSFUL trial flight was made on January 10th by the new French airship "E 9," built for the French Navy by the Zodiac concern. The airship, which is of the semi-rigid type, is driven by two 350 H.P. engines, has a capacity of 10,000 cubic metres, and will carry eleven passengers. It was piloted by Monsieur Debroutille, the chief pilot of the company.

THE Mersey Tunnel Joint Committee has provisionally fixed the date of the opening of the new Mersey £6,000,000 tunnel for July next year, says the *Birmingham Post*. The complete ventilating plant is not expected to be installed by that date, but temporary plant costing about £40,000 or £50,000 will be fixed. The total cost of the complete plant is estimated at about £1,000,000.

THE Department of Overseas Trade announces that Mr. N. Elmslie, H.M. Senior Trade Commissioner in South Africa, is now in this country on an official visit. Mr. Elmslie will be available at the offices of the Department of Overseas Trade during the period January 30th–February 4th, for the purpose of interviewing manufacturers and merchants interested in the export of United Kingdom goods to the Union of South Africa and to Southern Rhodesia.

IT has been decided to form a new local section of the Institution of Production Engineers in Yorkshire, with headquarters at Leeds. Mr. James G. Young (works manager, Sanderson Brothers and Newbould, Ltd., Sheffield) has been elected first Section President, and the hon. secretaries are Mr. H. C. Newell (Leeds Technical College) and Mr. A. E. Cutler (Bradford). The first public meeting of the new section is to be held in the Metropole Hotel, Leeds, at 7.30 p.m. on Monday, January 30th.

THE announcement is made that Royal Mail Lines, Ltd., has sold the steamer "Arcadian" to Japanese shipbreakers. She was built in 1907, as the "Asturias" and did excellent service in the Australian and South American trades. In 1919 she was reconditioned and renamed the "Arcadian," and was utilised for cruising in the New York–Bermuda services of the company. Recently she was laid up in Southampton Water, and many of our readers will recall that she was the ship lent by her owners for the demonstration of the automatic light control system of fire protection.

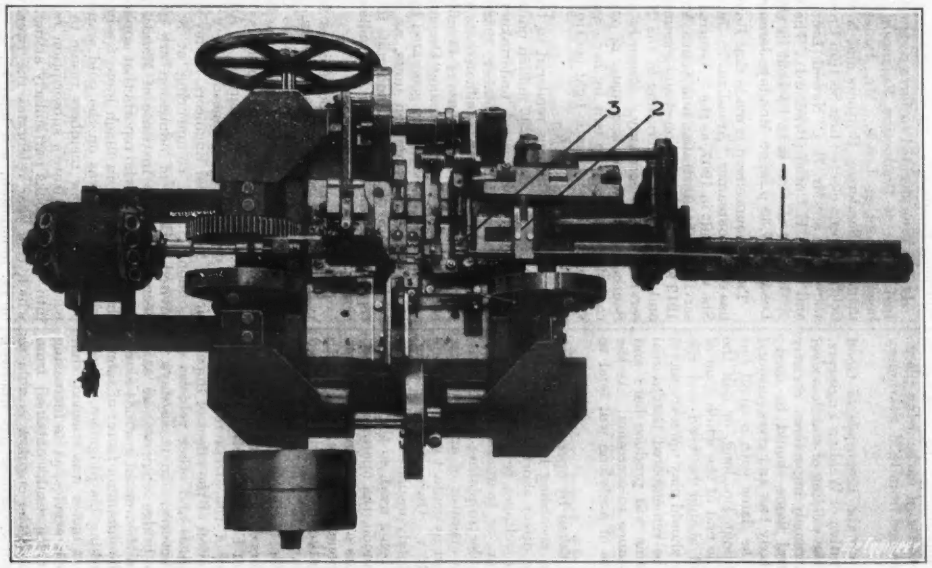
THE Official Returns rendered to the Electricity Commissioners show that 1266 million units of electricity were generated by authorised undertakers in Great Britain during the month of December, 1932, as compared with the revised figure of 1223 million units in the corresponding month of 1931, or an increase of 43 million units or 3·5 per cent. During the year ending December 31st, 1932, the total amount of electricity generated by authorised undertakers was 12,224 million units, as compared with the revised figure of 11,413 million units for the previous year, representing an increase of 811 million units or 7·1 per cent.

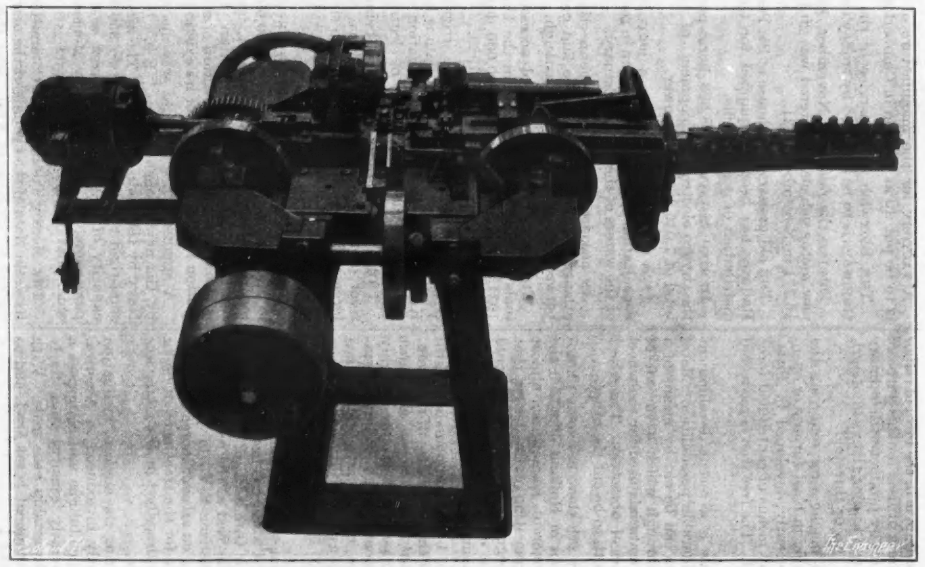
THE President of the Société des Ingénieurs Civils de France, Monsieur Albert Portevin, has accepted the invitation of the Institute of Metals Council to give the next Annual May Lecture before the Institute. Monsieur Portevin has chosen as the title of his discourse, "Quenching and Tempering Phenomena in Alloys." The lecture will be delivered on Wednesday, May 10th, at the Institution of Mechanical Engineers, Storey's-gate, Westminster, London, S.W.1, commencing at 8 p.m. Visitors are invited. Cards of admission are obtainable from the Secretary of the Institute of Metals, 36, Victoria-street, London, S.W.1, who reports that applications for membership are flowing in much more freely than was the case when England was on the gold standard. Over 30 per cent. of the new members reside in the United States, where the Institute's subscription rate, when converted into dollars, looks particularly attractive. The Institute, which this year celebrates the twenty-fifth anniversary of its foundation, will hold its annual general meeting in London on March 8th to 9th. Upwards of a dozen papers will then be presented for discussion.

AUTOMATIC HIGH-SPEED WIRE AND STRIP FORMING MACHINES

JAMES WARD (WORCESTER), LTD., WORCESTER, ENGINEERS

(*For description see page* 60.)





Figs. 15 and 16—The Paper Clip Making Machine is shown in plan and elevation. The wire enters by the straightener 1 on the right, is fed forward by 2 and gripped at 3. On the left the motor which drives the pointing tool can be seen.

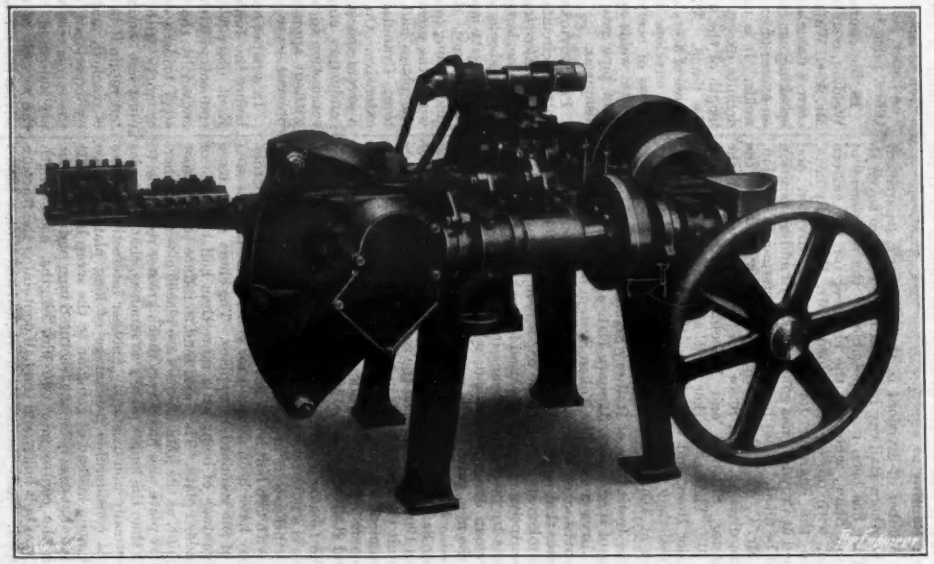


Fig. 17—Multiple Slide Press for Wire, with vertical slide. The feed lever is seen on the left.

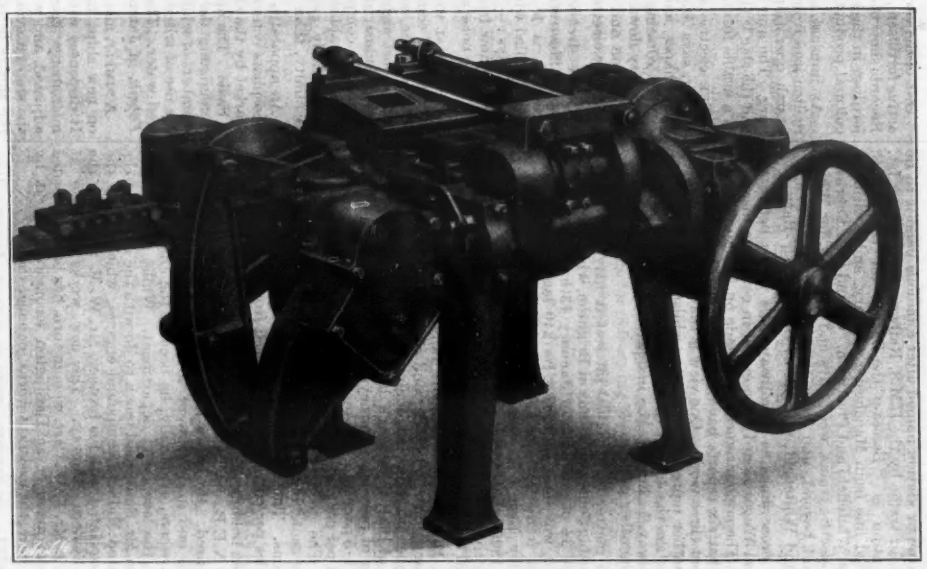


Fig. 18—Multiple Slide Press for Strip, with braced frame to take punching tools for making component shown in Fig. 13, p. 62.

The Engineer

JANUARY 20, 1933.

VOL. CLV. No. 4019

Contents.

THE ENGINEER, January 20th, 1933. PAGE

A SEVEN-DAY JOURNAL .. 59
AN AUTOMATIC WIRE-FORMING MACHINE. (Illus.) .. 61
THE INTERNATIONAL RAILWAY CONGRESS. No. I. .. 63
THE PHYSICAL SOCIETY'S EXHIBITION. No. II. (Illus.) .. 64
THE COMPRESSION-IGNITION ENGINE AND BRITISH RAILWAYS. (Illus.) .. 66
PRODUCTION OF IRON AND STEEL IN 1932 .. 67
LETTERS TO THE EDITOR—
Oil-electric Locomotives—Unemployment of Professional Engineers—Steel Foundries and Fabrication—Steel Railway Coaches—Municipalities and Foreign Contracts—Egyptian Locomotive of 1859 .. 68
KOENIG AND THE POWER PRESS .. 68
THE QUARTER'S SHIPBUILDING RETURNS .. 68
RAILWAY AND ROAD MATTERS .. 69
NOTES AND MEMORANDA .. 69
MISCELLANEA .. 69
LEADING ARTICLES—
Oil Locomotives .. 71
The International Railway Congress .. 71
BOOKS RECEIVED .. 72
OIL ELECTRIC LOCOMOTIVES: INSTITUTION OF MECHANICAL ENGINEERS .. 72
UNEMPLOYMENT AND ENGINEERING .. 73
SIXTY YEARS AGO .. 73
BILLINGSGATE FISH-BOX TRANSPORTER. (Illus.) .. 74
COLONIAL FUEL OILS .. 74
INTERNAL TRANSPORT IN WORKSHOPS. (Illus.) .. 75
A PORTABLE AIR COMPRESSOR. (Illus.) .. 75
NEW B.B.C. HIGH-POWER TRANSMITTER. (Illus.) .. 75
THE MOTOR TUG "JOHN WILSON." (Illus.) .. 76
GAS ENGINE STARTED BY A WATER TURBINE .. 76
WATER HEATING AND STEAM-RAISING PLANT AT BELFAST. (Illus.) 76
PROVINCIAL LETTERS—
The Midlands and Staffordshire—Lancashire .. 77
Sheffield—North of England—Scotland .. 78
Wales and Adjoining Counties .. 79
BRITISH STANDARDS INSTITUTION .. 79
EDUCATIONAL INTELLIGENCE .. 79
PERSONAL AND BUSINESS ANNOUNCEMENTS .. 79
CONTRACTS .. 79
LAUNCHES AND TRIAL TRIPS .. 79
CALENDARS, DIARIES, &C. .. 79
CURRENT PRICES FOR METALS AND FUELS .. 80
FRENCH ENGINEERING NOTES .. 81
BRITISH PATENT SPECIFICATIONS. (Illus.) .. 81
FORTHCOMING ENGAGEMENTS .. 82

NOTICES TO READERS.

*** *If any Subscriber abroad should receive* THE ENGINEER *in an imperfect or mutilated condition, he will oblige by giving prompt information of the fact to the Publisher, with the name of the Agent through whom the paper is obtained. Such inconvenience, if suffered, can be remedied by obtaining the paper direct from this office.*

*** *For Subscription rates, see page 2 of Advertisements.*

*** *All letters intended for insertion in* THE ENGINEER *or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

*** *No undertaking can be given to return drawings or manuscripts; correspondents are therefore requested to keep copies.*

DEATH.

ON January 16th, at Raynes Park, THOMAS CHARLES PULMAN, M. Inst. C.E., M.I. Mech. E., Director of Worthington-Simpson, Ltd.

OIL LOCOMOTIVES.

THE ideal debate on oil-engined locomotives has still to be held. Colonel Fell's paper at the Institution of Mechanical Engineers on Friday last gave an admirable opening. But it was not seized. Not a single railway man took part in the discussion. It is unfortunate perhaps that the presentation of the paper coincided with the Railway Conference in Cairo, but we cannot believe that so many of the engineers and managers of railways, at home and abroad, have gone thither that none were left to add to the value of the debate. It was noticeable, too, that no steam locomotive builders took part. That was almost as regrettable as the absence of railway men, for on at least one very important point they might have removed uncertainty. The result of these absences was that, for the greater part, the discussion turned upon oil engine problems. Within that limitation it was admirable. The speakers, almost without exception, kept closely to the text, and as they were all men with practical experience, many valuable observations were made.

Colonel Fell's paper divides itself into two parts. The first deals with the general problem of oil-electric locomotives, whilst the second is an advocacy of light high-speed engines in place of those now generally employed. This part may be dismissed here in a very few words. The meeting, as a whole, or so we felt, was more in sympathy with those, led by Mr. Richard Allen and Professor Lomonossoff, who preferred medium speeds, than with the author. It seems not improbable that railway engineers will prefer to advance slowly and will continue to favour the heavy type of engine rather than one that smacks of the motor-bus or the aeroplane. But the experience of high-speed engines is now so vast, and the evidence of their reliability is so convincing, that before long their advantages for rail traction must be weighed against the anxieties which they now inspire. The actual percentage saving in the total weight of the power and traction equipment by a reasonable increase of engine speed may not be great but, unless we have misunderstood the author, he was thinking, in fact, more of the reduction of cost than of the reduction of weight. If the high-speed engine can, indeed, be produced for £2 10s. per H.P., as against nearly double that for engines of current types, it will certainly have to be very carefully considered. The high-speed engine has another advantage which is far from negligible; that is, the space it occupies. If there were no saving in weight whatever—and even a small percentage is not to be despised—these two merits, less prime cost and less space, would compel attention. The question of price brings us back to the first division of Colonel Fell's paper. Here, as will be seen from the reprint on page 66 of this issue, he presents two tables of quite unusual interest. It is well known that with few exceptions the oil locomotive has been favoured by railways, both at home and abroad, principally for shunting and freight and slow speed services. Table I. of our reprint shows that the reason for that preference is an economic one. In other words, the express oil locomotive is debarred by the fact that the express steam locomotive is cheap on a B.H.P. basis, by comparison with the slow steam locomotive. The table is a very important one, and we regret that it was not searchingly examined by a locomotive builder. There was, indeed, some criticism of it, but it was not overthrown. It must be admitted that at the present time it is not easy to get at real, economic prices for any engineering products, locomotives included. The figures given may, therefore, call for some modification, but we say with some certainty that steam locomotives, for British lines, cost new about £85 to £87 per ton. If that be a correct figure, the disparities in Colonel Fell's table might be reduced, but they would not disappear, and it would still remain true that per horse-power the express engine is much cheaper than the slow engine. That is why the express oil locomotive is not considered by British railways, whilst slow-speed, low-power types are being regarded more sympathetically. According to Colonel Fell's figures, oil-electric locomotives for main line passenger and express goods services are three times as costly as corresponding steam engines. The ingenious arguments advanced by the makers of oil locomotives have been insufficient to overcome this handicap under the conditions of British railways which are favourable to steam. But the discussion threw considerable doubt upon the reliability of Colonel Fell's second Table. It gives the cost per horse-power of oil-electric locomotives as £13 10s. In reaching this figure the oil-engine unit has been debited with only £2 10s. per B.H.P. It was manifest that the participants in the discussion and members in the body of the hall regarded that as an absurdly low price, a more reasonable one being £4 10s. One speaker, with a probable bias towards electrification, challenged the third item also. He would have raised it from £3 up to £4 per B.H.P. On that point there is not sufficient evidence, but when, in his reply to the discussion, Colonel Fell made it clear that the figure of £2 10s. for the engine unit was based on a proposed relatively high-speed type, it was obvious that it was much too low for the slow-speed engines now offered. The matter is, of course, of considerable consequence, and one could wish for an authoritative statement from the builders of oil-electric locomotives. It seems, however, that the price is actually nearer to £16 per B.H.P. than to £13 10s. Hence the disparity between the competitive types for passenger and express goods engines is greater than given by the author, and even the comparison between lower-powered engines is not so favourable as his figures would make it appear.

So many people have been brought to the opinion that the failure of the oil locomotive to make rapid progress on British railways is due to nothing more than an ingrained prejudice in favour of steam, that we make no apology for having stressed this question of price rather than some of the technical points that were raised in the discussion. The problem is, in fact, entirely an economic one. In the simplest form it may be expressed thus: A single oil-electric main line passenger locomotive will consume, in pounds sterling, about half as much fuel as a steam locomotive. But it will cost in round figures £20,000 more to buy. Let us assume that the steam locomotive consumes £1500 worth of coal per year. Since the oil engine will save £750 on fuel per year, it would take $20{,}000 \div 750 =$ about $26\frac{1}{2}$ years to pay back the extra cost. We are quite aware that this is simplifying the argument to excess, and that the case for the oil locomotive, even for express work, is far better than this little sum makes it appear. Nevertheless, it does show very clearly indeed, that only when the price of the oil locomotive approaches the price of steam locomotives—as it does for low powers and low speeds—that it becomes really attractive from the economical point of view. It shows also that in other lands than this, lands in which fuel is more expensive, and where even water is costly, there is a much more promising field for the oil locomotive. Furthermore, it shows how necessary it is, on the one hand, for the oil locomotive builders to consider every possible method of reducing the prime cost of locomotives—including Colonel Fell's suggestion of high-speed, light-weight engines—and, on the other hand, that if the makers of the smaller classes of steam locomotives wish to meet the coming competition of oil-engined locomotives they also must study the possibility of reducing the price per horse-power.

The International Railway Congress.

IT seems only the other day that we reviewed the reports submitted to the eleventh meeting of the International Railway Congress, held in Madrid in May, 1930. Now we begin in the present issue to give summaries of those reports of special interest to engineers which are to be discussed by the Congress at Cairo. The International Railway Congress Association is decidedly international in its composition, as it represents 230 railway systems, both State and privately owned, from all parts of the world. The subjects to be considered are determined by a permanent commission sitting in Brussels. They come under five sections, of which the first, second, and third cover, broadly, civil engineering, mechanical engineering, and operation. Each section takes four or five subjects, on which, usually, there are three reports, but sometimes four and, on minor matters, only two. Each report covers a series of countries in which the conditions are fairly similar. As a rule, one author is responsible for each report, but occasionally there is joint authorship of two, and sometimes three persons. At Madrid twenty subjects were dealt with in seventy-five reports, of which twenty were jointly submitted; at Cairo there are only thirteen subjects, covered by thirty-six reports, of which twelve are joint reports.

As we have observed before in this connection one of the great values of these reports lies in the fact that they are all prepared by men in the highest rank of their particular profession, who, moreover, go to no end of trouble to make their labours worthy of the occasion. This leads to a large amount of information being given, which, under other circumstances, would be regarded as confidential. Moreover, it is presented in a manner that allows comparisons readily to be made between the work of one country and another, or between that of one company and another. A particular merit of these reports is that never do their authors allow their personal views to prejudice the opinions expressed. Over and above the value of the reports there is the great benefit gained by administrations as well as by individuals, in the association together of railwaymen from every part of the world. Each country sends of its best; not only its ablest railway engineers and officers, but administrators like, taking our own country, Sir Evelyn Cecil and Mr. Douglas Vickers, who are respectively eminent in the political and commercial life of the country. The various Governments also send, as they are entitled to do, representatives. Is it not possible, nay, is it not likely, that such a gathering of able men may bring some influence for good to bear on the present confused political and industrial condition of the world at large? In the present issue three subjects presented to the Congress are dealt with and, later, we hope to review the reports on electrification, all-metal rolling stock, automatic train control and other subjects. For the first time the various reporters have apparently agreed as to the heads their reports should cover. The greater need for the protection of both the railway and the road at level crossings, arising out of the growth of motor road transport, is the first subject to be considered in the civil engineering section. Therein Mr. Newlands draws attention to the fact that, in former days, a check of five minutes at a crossing meant a time-distance loss of 800 yards or so to a horse-drawn vehicle, but to-day it involves a loss of four or five miles to a motor vehicle. He, it will be seen, recommends in effect an international system of level crossing protection. Monsieur Baticle, on the same subject, relates how all the countries he reports upon have taken some action to improve the safety of level

crossings. Some administrations, he says, found their regulations out of date and so rigid that they interfered with the modernisation of the methods for securing safety. The regulations were thereupon changed, but the modifications were often accompanied by a large number of rules which did not always simplify the position. Mr. Miske points out that whilst, in the old days, the level crossing was the most dangerous part on a road, there are, to-day, fewer accidents at crossings than on other portions of the highway. In his report on track matters, considered under Question II., Mr. Thomson, an American engineer, speaks of the economic advantages of smaller local gangs for maintenance work; with floating gangs, properly equipped with mechanical labour-saving appliances for the heavier work. He records that English experience shows that the reconditioning of permanent way crossings by electric welding can be done at one-fifth of the cost of replacing them, and that after the crossing has been built up there are good grounds for anticipating a further life approaching in length its previous life. The reporter on this subject for the German railways says that the advantages gained there from the uses of mechanical appliances in track work produce an economy of 50 per cent. The same reporter shows how mechanical appliances are discouraged by some Governments in Eastern Europe, as they tend to increase unemployment. It will be noticed that the three Japanese engineers consider that the axle load and wheel spacing should be considered in relation to track, just as they are to bridges. Sir Henry Fowler, when reporting in Section II., which we shall deal with in our next issue, on the mileage to be run by locomotives between two repairs, mentions work to which the name of "intermediate repairs" is given, and says that two railway systems definitely state that an increase of 20 to 25 per cent. of the mileage is the result of such intermediate repairs. Herr Student, of the German railways, observes that, whilst there may be controversy as to the need of intermediate repairs, his own opinion is that they are indispensable for economical locomotive operation. His statement as to the beneficial effects of the recent reorganisation of the repair shops in Germany merits attention; he reports a reduction of 50 per cent. in the time taken for repairs. Among other reports that we shall summarise is one which indicates why so much progress has been made with electrification in France. Another will be that by Mr. Gresley on all-metal vehicles, wherein the situation as regards passenger vehicles on the London, Midland and Scottish, and the London and North-Eastern is discussed, and also the progress in all-metal wagons generally. Reasons against such wagons in Germany are given in another report. The question of automatic train control is covered by three reports, in one of which the preference in France for cab signals is made very evident.

It is sometimes said that the interval between the Congresses is too short. Up to the Madrid meeting of 1930 a period of five years elapsed between the meetings, but it was then decided to meet at three-year intervals. Those who prefer the longer interval aver that events do not move quickly enough for any new developments to be recorded. That, for instance, is the opinion expressed by Monsieur Mariani, who, in reporting on all-metal vehicles, says that in that short period no great evolution could be expected in the construction of metal coaches. Another complaint relates to the demands on the administrations which have to answer the questions addressed to them. Both these objections are reasonable, but they appear to be answered by the fact that the times are serious, and that if such questions and their replies, and the meetings which follow them lead to better administration, the spread of knowledge, and happier relations among railwaymen, some self-sacrifice is well worth while.

BOOKS RECEIVED.

Compressed Air Terms and Standards. London: British Compressed Air Society, 76, Victoria-street, S.W.1. Price 1s. net.

Symposium on Steel Castings. Philadelphia: American Society for Testing Materials, 1315, Spruce-street, Pa., U.S.A. Price 1 dollar net.

Grundlagen des Stahlbaues. By Dr.-Ing. G. Schaper. Berlin: Verlag von Wilhelm Ernst und Sohn, Wilhelmstrasse 90, W.8. Price 22 marks.

The South and East African Year Book and Guide, 1933. London: Union Castle Steamship Company, Ltd., 3, Fenchurch-street, E.C.2. Price 2s. 6d. net.

Jane's All the World's Aircraft, 1932. Edited by C. G. Gray. London: Sampson Low, Marston and Co., Ltd., 100, Southwark-street, S.E.1. Price £2 2s. net.

Oil-Electric Locomotives.

INSTITUTION OF MECHANICAL ENGINEERS.

ON Friday evening, January 13th, Lieut.-Colonel L. F. R. Fell presented before the Institution of Mechanical Engineers a very interesting paper on "The Compression-ignition Engine and its Applicability to British Railway Traction." An abstract of this paper appears elsewhere in to-day's issue, and from it it will be seen that Colonel Fell treated his subject in an impartial spirit. He demonstrated that for powers of 1000 B.H.P., and over, the high first cost of the oil-electric locomotive offset the undoubted advantages which it possessed, and that it was as a consequence unsuitable as a substitute for the steam locomotive on main line express passenger and express goods services. Nor was it very attractive, for the same reason, as a substitute for electrification on inner suburban lines. He argued, however, that the compression-ignition oil-engined locomotive with electric transmission was suited to a wider field of duties than some critics would allow, and showed that for mineral transport, for branch line passenger work, for goods transport as now performed by standard 0–6–0 steam locomotives, and for shunting work it possessed undoubted claims to the attention of British railway authorities.

The paper was one in which railway engineers might have been expected to manifest considerable interest. As it was, they held aloof from the discussion. Neither in person nor by representative was the voice of any railway engineer heard, and to that extent, but to that extent only, was the discussion disappointing.

Mr. Oliver Thornycroft, speaking on behalf of Mr. H. R. Ricardo, discussed the high-speed oil engine, and emphasised the advantages which the sleeve-valve type possessed, as regarded freedom from wear. He gave particulars of the wear measurement on a medium-speed sleeve valve engine running at 750 r.p.m., corresponding to a piston speed of 1500ft. per minute. After 7700 hours' running, the maximum wear of the sleeve measured on the diameter was found to be only 9 thousandths of an inch, or 1·2 thousandths per thousand hours, whereas in a comparable engine of the fixed liner type the wear of the cylinder liner would be not less than 4 thousandths of an inch per thousand hours. The sleeve valve of the engine he had referred to was of ordinary iron centrifugally cast. There was, he said, much evidence for the belief that liner wear was partly a chemical effect, and the rate of wear was therefore dependent more upon time than upon number of cycles. For example, it had been noted that the wear was increased by an increase in the consumption of lubricating oil. It was difficult to account for that fact, except on a chemical basis. He also advocated the merits of supercharging engines for oil locomotives. By its adoption, he said, the power of the engine could be increased 25 per cent. for an increase of only 3 per cent. in the fuel consumption, and for an increase in the cost of the engine of less than 10 per cent. He added that, in his opinion, the maintenance costs would not be raised.

Wing-Commander Cave-Brown-Cave argued that the claims of evaporative cooling deserved serious consideration. It was coming more and more into use in aircraft engines. One great advantage resided in the fact that the heat being in a fluid, steam, of low density, it could be economically transmitted to a great distance for any useful purpose. For example, in the airship "R 101" the steam produced by the engine cooling system was transmitted 150ft., and used in radiators for warming the passengers' quarters. In an oil-engined locomotive the steam, he suggested, might be used for driving a supercharger. The system dispensed with the necessity for using a circulating pump, and, in addition, the fan ordinarily associated with a radiator could be eliminated. He was not convinced that Colonel Fell was wholly correct in asserting that the oil-electric locomotive was unsuitable for main line passenger trains.

Mr. C. Corbridge argued that the author should have given a list of the disadvantages, as well as of the advantages of the oil-electric locomotive. Those disadvantages, as compared with straight electrification, consisted of more than the high first cost. Criticising Colonel Fell's figures for the cost of oil-electric locomotives, he attacked the figure of £2 10s. per B.H.P. given for the oil-engine unit, and asserted that £4, £4 10s., or even £5 might have been expected. He also criticised the curve reproduced as Fig. 2 in our abstract, and the author's suggested use of a speed of 1500 r.p.m. for a 500 H.P. engine. That speed, he said, was rather high. A speed of 1000 r.p.m. would give a more robust engine, and one better suited to the conditions of railway maintenance. When speeds of 1000 r.p.m. and over were employed, conditions of aero-engine practice were approached, and accordingly he doubted whether the first cost would continue to decrease above 1000 r.p.m. in the manner shown in Fig. 2. The figure of £8 given for the cost of electric equipment by Colonel Fell was perhaps reasonable, although it was to be noted that the electrical equipment for an oil-electric locomotive was more costly than the equipment for straight electrification. The figure of £3 allowed under the heading "installation" was probably too small, and should be more nearly £4. Altogether, he thought that Colonel Fell was an optimist if he expected to be able to obtain a 1000 H.P. oil-electric locomotive for £13,500. Turning to the curves reproduced in Fig. 1 of our abstract, he questioned the author's conclusion that there was little advantage in adopting a power-weight ratio of 10 B.H.P. per ton over one of 4 B.H.P. per ton. He held that Colonel Fell's curves were not comparable for the coasting period, and showed an amended diagram intended to bring out the very considerable saving of time obtained by adopting a power-weight ratio of 10. He also exhibited a diagram to show the manner in which the steps in the speed obtainable by means of a mechanical gear change resulted in loss of time on a trip, as compared with the continuous speed change obtainable with electric transmission.

Mr. R. W. Allen asked whether the question of first cost was really the critical factor which the author had made it. He suggested that reliability would be the first consideration which railway engineers would take into account, and argued that on that score the oil-electric locomotive would be held to be too complicated for shunting work. He favoured a lower speed and a more robust engine than that proposed by the author. It had, he said, to be borne in mind that the engine would not receive the same expert and continuous attention as one in use in the Royal Air Force. He was surprised at the figure of £2 10s. per B.H.P. given by Colonel Fell for the cost of his oil engine unit. It would, he said, be a wonderful achievement if it could be realised in the conditions prevailing to-day.

Mr. E. H. Croft expressed himself as being in agreement with Colonel Fell as regarded the services for which the oil-electric locomotive was suitable, but disagreed with his contention that the steam locomotive was without a rival on main lines. Electrification would, he said, beat it every time. He did not like the proposal to mount the engine on a bogie, as it would result in concentrating the weight at a low centre of gravity. Evaporative cooling in an oil-electric locomotive would certainly be advantageous, as it would solve the carriage heating problem, which was a source of some difficulty in straight electrification.

Professor Lomonossoff said that the author's conclusions agreed in the main with those which he himself had expressed in 1920 and 1924. Much had happened in the meantime. The first Russian oil-engined locomotive had now run 250,000 miles. About a hundred oil-electric locomotives were in operation in America. Denmark and Siam had decided to build nothing but oil-engined locomotives in the future. In Germany and Russia oil-engined locomotives, with all four forms of transmission, had been thoroughly tested. We had therefore now passed from the region of guesswork and assumption to that of facts and accurate figures. Experience had shown that purely hydraulic or pneumatic transmissions were scarcely promising, although hydraulic transmissions which were required to act only for a short time deserved careful consideration. No difficulties had been encountered with mechanical transmissions for powers of 500 H.P. or less. The Russian locomotive of 1200 H.P. with gear transmission had been at work for six years, in spite of a number of mistakes which he (the speaker) had made in its design. A similar passenger locomotive of 1500 H.P. was now being constructed in Russia. The efficiency of mechanical transmission sometimes reached 96 per cent. and on the average its cost was 35 per cent. less than electric transmission. Against all expectations it had been found that on the average the cost of repairs for oil-engined locomotives was no greater than for steam locomotives, and if the water were bad the cost was considerably less. Generally speaking, the cost of the fuel oil and the quality of the water were the two main factors determining whether oil-engined traction was profitable or not. Even if oil-engined locomotives cost five times as much as steam locomotives, in districts possessing very poor water and cheap fuel oil the use of oil-engined locomotives would still be profitable even for main line working. If, however, fuel oil were extremely cheap, oil-engined traction became unprofitable. In the extreme case, assuming that the fuel oil was free, it would obviously be more economical to burn it in comparatively cheap steam locomotives than in the more expensive oil-engined locomotives. His investigations showed that oil-engined traction was most profitable in those regions where fuel oil cost approximately twice as much as coal. That consideration led him to the conclusion that at present oil-engined traction could not expect wide application in Great Britain. The production of cheap liquid fuel from coal might, however, alter the position. According to Colonel Fell's figures the electrical equipment of an oil-electric locomotive represented about 60 per cent. of the total cost of the locomotive. According, however, to

German and Russian experience, it accounted for only 32 per cent., the actual figures of cost per horse-power being :—Oil engine unit, £5 ; electric transmission, £5 ; locomotive portion and cooling equipment, £4 5s.; inspection and shipping, £1 ; total, £15 5s. per horse-power. He did not agree with the author that railway conditions required an engine running at 1500 r.p.m. Nothing was to be gained by going above 600 r.p.m. or below 30 lb. per B.H.P. It was also to be remembered that reduction in weight could be achieved not only by increasing the speed, but also by increasing the mean indicated pressure. On the Russian locomotives which used air injection the mean indicated pressure reached 150 lb. per square inch. He agreed with Colonel Fell's opinion regarding evaporative coolers. Unfortunately, such coolers lost water and were therefore unsuitable for waterless regions, for which oil-engined traction was otherwise especially well adapted.

Lieut.-Col. A. E. Davidson expressed surprise that the question of mechanical *versus* electric transmission had not been prominently debated. The author gave £8 per B.H.P. as the cost of electric transmission, but £4 10s. per B.H.P. had been realised for mechanical transmission, and that on orders involving small quantities. He, like other speakers, criticised the author's figure of £2 10s. per B.H.P. for oil engines, and said that if he could get them for that figure he would be very well pleased. Discussing the use of evaporative coolers, he remarked that in high-speed oil engines the main bearings were a common source of trouble, and it was therefore very important to ensure that the temperature of those bearings was not adversely affected by the adoption of very high cooling temperatures.

Mr. J. F. Alcock also thought that mechanical transmission had been dismissed too briefly. It had suffered perhaps from being tried at powers beyond its true range. Up to 125 or 150 H.P. it was satisfactory. If a 500 H.P. locomotive was required he suggested that it might be designed with four engines and four gear-boxes, each engine perhaps being arranged to drive a separate axle. The arrangement would incidentally facilitate the maintenance and overhaul of the power units. Dealing with evaporative cooling, he remarked that with good water, such as we had in this country, there was no reason why sufficient water should not be carried to enable it to be blown off as steam, so permitting the cost of the condenser and fan to be saved. The water required under this scheme for a 500 H.P. locomotive at 60 per cent. load factor would only be about 50 gallons an hour.

Mr. A. Orton remarked that while he admitted with the author that oil-electric locomotives had very little chance of employment on close suburban work, he was a little more hopeful than Colonel Fell as regarded their use on main lines. His firm, Armstrong, Whitworth and Co., Ltd., was advancing from the slow-speed marine type of engine as the basis because of its reliability and was not endeavouring to produce a very light engine. The attainment of extreme lightness in the engine was not of very great importance from the point of view of running costs. He assumed as examples two locomotives, each weighing 100 tons and each fitted with a 500 B.H.P. engine and generator. In one case he supposed the power plant to weigh 15 tons and in the other 7½ tons. The weights of the locomotives less their power plants would therefore be 85 tons and 92½ tons. Assuming the same fuel consumption for any particular duty, the relative total fuel quantities used per ton of weight pulled would be :—Fuel÷85 and fuel÷92·5. There would therefore be an advantage of 8 per cent. in favour of the light engine. It was, however, fairly accurate to take the fuel cost as being only about one-quarter of the total running costs, the other items being independent of the engine size or performance. The 8 per cent. saving of fuel therefore represented only 2 per cent. saving on the total running costs, in spite of the fact that it was based on a 50 per cent. cut in the engine and generator weight.

Mr. H. A. D. Acland endorsed the use of evaporative cooling, but asked why it should be suggested that the steam produced should be used to drive a supercharger. Either the steam would have to be at super-atmospheric pressure or it would be necessary to provide a condenser to maintain a vacuum.

Replying to the discussion, Colonel Fell remarked that the price of £2 10s. per B.H.P. which he had taken for the oil engine unit did not seem to him to be unduly low in view of the fact that to-day aero engines were being sold at a price equivalent to less than £3 per B.H.P. Speed and reliability seemed to be regarded by several speakers as incompatible. He did not agree with that conclusion. The most difficult aircraft engine with which he had ever dealt was a slow-speed one, and recently the reliability of a particular engine had been increased by increasing its speed. It seemed to be suggested that in the curve of cost per H.P. there was a kink at the point corresponding to a speed of about 1000 r.p.m. So far as he knew there were no grounds for that suggestion. The curve continued to trend downwards, as he had shown it, with increase of speed. In his estimate of the cost of oil-electric locomotives the figure of £8 per B.H.P. for the electrical equipment was the lowest which he had obtained from any electrical firm in this country and included the cost of erection. The figures for the cost of steam locomotives were the lowest contract prices which had been placed at his disposal by one of the leading British companies.

Unemployment and Engineering.

(By Our Paris Correspondent.)

IN offering to Governments a plan of public works for the relief of unemployment on a scale that places it entirely beyond the financial possibilities at the moment, the International Labour Bureau at Geneva failed in its object, because, on its own confession, it lacked the technical knowledge to render the plan acceptable. It is now endeavouring to show the utility of such works by issuing a mass of statistics on unemployment whereby it hopes to demonstrate the extreme urgency of doing something to remedy a dangerous situation. As to the plan itself, the chances of carrying out public works all over Europe by means of an international grouping of capital appear remote, but there is no doubt that the statistics will impress upon everyone concerned the formidable character of a problem which is becoming more complicated and more difficult of solution every day. The danger of delay is implied by the statement that the world total of unemployed is at least 30,000,000. That number is increasing, and during the present winter "there will be more misery than at any time since the beginning of the century." Figures are given to show the colossal expenditure on unemployment relief. In Belgium the expenditure increased from 32 million francs in 1930 to 365 millions in 1931. In Germany, the total cost, including sums paid out under compulsory insurance, increased from 1151 million reichmarks in 1928 to 2973 millions in 1931. In Italy, Holland, Poland, and Switzerland there has been the same alarming progression in the amount paid for relief. The loss of wages is one direct cause of the fall in prices, because there is less to spend on essential commodities. Taking as a basis a total of 24,000,000 unemployed in twenty countries, it is estimated that the purchasing power has been reduced by no less than 4200 million pounds sterling gold. While that figure represents a higher wage level than can be accepted for most foreign countries, it nevertheless conveys a definite idea of the main factor that underlies the world economic depression.

If it be assumed that the phenomenal loss of purchasing power in the twenty countries to which the figures apply is considerably more than the loss of trade, there is little to justify the belief that the world crisis can be attributed primarily to over-production. There is, naturally, always a danger of the output of certain classes of standardised goods outstripping demand as the result of continued improvements in mechanical processes, but for general engineering products there is no reason for supposing that the existing means of production will exceed the world's purchasing power as judged by the single fact of what that power would be with a recovery of wage losses. Foreign economists are tempted to attribute much of the trouble to mass production, principally because it has influenced other branches of industry which are less adaptable to a standardised output, and the displacement of labour by machinery in an effort to bring down costs under highly competitive conditions is regarded as being largely responsible for the intolerable burden of unemployment. It is, therefore, argued that a remedy for this state of things should be found in controlling the use of machinery. This can obviously only be done by those who have most experience in the use of machines, and can decide to what extent they can be employed with advantage to the employer and without suppressing labour unduly. In other words, it is a question of general interest whether labour should be sacrificed to a reduction of costs, or whether the men would be content to accept wages that will compensate employers for economies they could effect by accelerating production with new machinery. This, of course, depends upon the men themselves and upon world competition, which two factors have always encouraged the use of labour-saving machinery. The machine will always win in the end, but in present circumstances it is vanquished by the blight of unemployment, which, in the opinion of foreign economists, can only be remedied by the control of machinery. Unemployment has reached a peak that over-tops every other consideration, and any move in the direction of organising industry must be made with a view to absorbing as many men as possible. It is a technical job that can only be undertaken by qualified men who are able to adjust the interests of employers and labour upon a basis that will take into account the revolutionary changes in the world's economic situation. This necessitates a wide knowledge of the condition of things on the Continent, and it is largely responsible for the attempts that are now being made to group engineers into an international body which will give them the power to take decisive action in bringing about an industrial recovery.

The revolutionary changes arise out of a partial redistribution of Continental resources in raw material and the industrial development of countries that were formerly markets for British goods. Hundreds of thousands of men went into works and factories all over Europe during the industrial boom at the beginning of the present decade, and they have swollen the ranks of unemployed with little prospect of many of them finding similar work again. All this depends upon whether industrial nationalism will resist the shock, or whether artificially created industries will collapse under pressure of national necessities. The need for foreign trade expansion is so urgent that Continental countries will be compelled to sacrifice some national interests, and as a development of exporting industries will alone solve the problem of unemployment a removal of artificial encouragement to new industries, as the result of treaty negotiations, may again open Continental markets to British goods, though British makers know quite well that they will never recover their old privileged position in Europe. Continental industry has developed artificially in some directions, and may have to be more or less sacrificed in a general organisation, but in other directions it has expanded considerably and is a dangerous factor to be reckoned with in the future. For the moment, each country will have to work out its own problem of unemployment by developing the export trade in essentially national industries. It cannot be done by schemes of international works which, at the best, could only provide occupation for a very small percentage of the total number of men out of employment, and that, too, at a cost out of all proportion to the results obtained. The most startling deduction from the figures supplied by the International Labour Bureau is that the bulk of the huge mass of unemployed in Europe must be given an opportunity to earn wages before the purchasing power of foreign countries will bring prosperity to manufacturing industries. This problem is so stupendous as to give vital importance to the forthcoming World Economic Conference.

SIXTY YEARS AGO.

THERE is a double interest in an article entitled "The Dangers of Uniformity in Scientific Education," which appeared in our issue of January 17th, 1873. It is, in the first place, of historical interest, because it was Macquhorn Rankine's last article. It had been written by him a very few days before his death, and had been intended as a leading article. Most of Rankine's communications to our columns had been in the form of signed contributions, but in a note accompanying his last article, we revealed the fact that, occasionally, very occasionally, he acted as one of our staff of leader writers. As recently as December 13th, 1872, a leader from his pen, entitled "Public Money for Public Ends," had appeared in our columns, and his last article was in the nature of a sequel to that leader. The second respect in which we find interest in "The Dangers of Uniformity in Scientific Education" is the fact that its argument is even more applicable to the conditions of to-day than to those prevailing when it was written. In "Public Money for Public Ends," Rankine had striven to combat the common opinion that the scientific education of an individual was wholly a private benefit to himself. He contended that it was a public as well as a private benefit, that the public advantage predominated, and that it was just and reasonable that the scientific education of individuals should be assisted by a liberal expenditure of public money. He foresaw, however, that if public money were to be expended in this manner, it would not be long before scientific education passed under Government control to become standardised and reduced to a dead level of uniformity throughout the country. Strongly individualistic as he was, Rankine shrank from such an outcome, and in his last article developed an argument to show that in diversity of thought and competition between schools of teaching lay the key to advancement in science and improvement in practice. Uniformity in methods of education, he contended, would engender a passive sluggishness. Let there be conflict between various ways of teaching and demonstrating and illustrating the same truths. By such diversity healthy mental activity would be encouraged and original thought would be promoted. The only uniformity which was always good in itself, said Rankine, was that of the works and laws devised by infallible wisdom. Uniformity applied to human institutions or to the devices of limited intelligence, and particularly in the fields of art and science, stifled originality, perpetuated error, hindered progress, and produced stagnation. It was a good thing that there should be many forms of steam engine, many ways of making steel, many schools of shipbuilding, and many schools of civil engineering, each with its own methods of working out its own ends.

WE hear that Mr. F. V. Russell, of the London and North-Eastern Railway, after having been connected with that railway and, previously, with the former Great Eastern, since 1886, is retiring. Mr. Russell was essentially a locomotive man and was the Great Eastern running superintendent at the time Sir Henry Thornton became the general manager in 1913. The latter, soon after his appointment, reorganised the traffic manager's department and made Mr. Russell the superintendent of operation, which position he held until the Great Eastern became part of the London and North-Eastern, when he became engaged on special investigations, mainly in connection with the proposed electrification. The splendid efforts made in July, 1920, to give an intensive train service into and out of Liverpool-street, as an alternative to electrification, which resulted in an increase of from 50 to 75 per cent. in the number of trains, were the results of Mr. Russell's enthusiasm.

Billingsgate Fish-box Transporter.

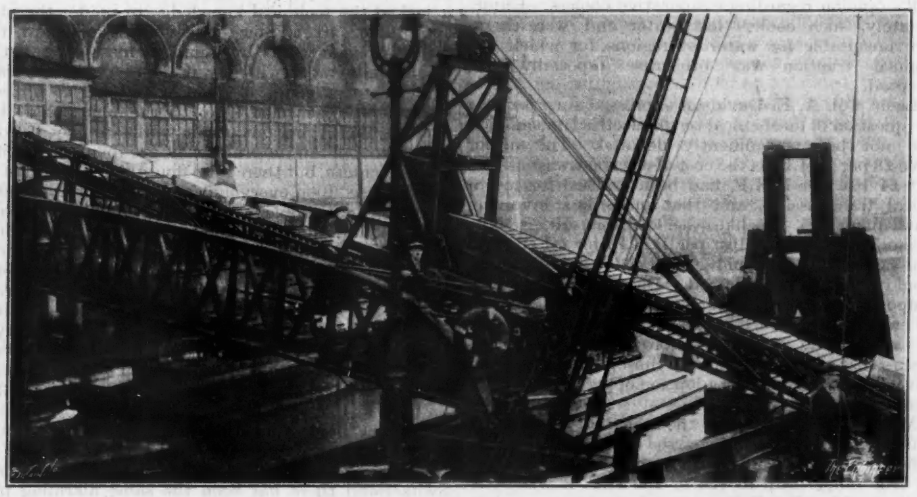
THE unloading of the carriers and the delivery of the boxes of fish to the auctioneers' stalls at Billingsgate Market was formerly carried out by porters, who passed up and down a bridge connecting the market buildings with a floating pontoon against which the carriers were

GENERAL VIEW OF TRANSPORTER

moored. The mechanical handling plant illustrated by the accompanying engravings has now been installed to do this duty. Designed by Babcock and Wilcox, Ltd., of London, in collaboration with Mr. Hayward, of Messrs. Kelsall Brothers and Beeching, trawler owners, the plant consists of two slat conveyors operating in conjunction with a fixed gantry roller conveyor. The main slat conveyor is mounted on the bridge connecting the market with the pontoon. At its lower end a second slat conveyor is so arranged on a hand-operated derricking boom that when not in use it can be hoisted clear of the pontoon. Each of the slat conveyors is 24in. wide and the elm wood slats are attached to a roller chain. The main conveyor is driven through worm reduction gearing by a 4 H.P. motor, while the boom conveyor is set in motion by a 2 H.P. variable-speed motor driving through spur reduction gearing. Both conveyors are fitted with protected type screw-operated take-up gear for adjusting the chain tension. The conveyor boom is mounted on trunnions carried on a movable under-carriage fitted with hand-operated rack gear arranged so that the boom can be adjusted laterally to suit the varying beams of the fish carriers, the derricking gear taking charge of any variation in freeboard or draught.

In operation, the conveyor boom is lowered over the deck of the trawler and the boxes are loaded by hand on to the end of the conveyor and transported on to a gravity roller table which discharges them on to the main conveyor mounted on the bridge. This conveyor in turn delivers the boxes on to the gravity runway serving the auctioneers' stalls. This gravity runway is built up of mild steel tubular rollers fitted with ball bearings and mounted on sectional portable under-carriages, a suitable curved gravity roller table being provided adjacent to the end of the main conveyor to divert the boxes to the main gravity runway, which is arranged behind the auctioneers' stalls. At each of the five stalls a take-off table is provided, which is built up of ball-bearing rollers similar in construction to the main runway. An attendant claims the boxes from the main conveyor as required and delivers them over the take-off table on to the auctioneers' bench.

The control gear is situated near the head of the main conveyor and is operated from a platform so placed that the attendant may observe the distribution of the boxes to the various auctioneers' stalls; he is in a position to start and stop the plant at any time and also to vary the speed of the boom conveyor to suit the requirements of the market. When the buying is brisk it is possible to handle 1200 boxes per hour from the fish carriers to the auctioneers' stalls. If, however, the market is not so good the speed can be decreased down to 600 boxes per hour on the boom conveyor which controls the rate of handling of the whole system.



THE LOADING END OF THE TRANSPORTER

GRAVITY RUNWAY SERVING AUCTIONEERS' STALLS

THE Consolidated Mining and Smelting Company, of Canada, is investigating the radium bearing ores of Quadra Island, on the coast of British Columbia.

Colonial Fuel Oils.

AT the beginning of last year a Mission left Paris for French West Africa in order to investigate the possibility of utilising locally produced vegetable oils for power purposes. It was organised as the result of the Congress of Colonial Oils that was held at the time of the International Colonial Exhibition in Paris in 1931, when, at a series of meetings spread over six months, the whole matter was thoroughly discussed. The papers and debates on the various aspects of the problem were summarised in these columns. The conclusions arrived at were that the chances of a country being able to substitute colonial oils for imported mineral oils appeared remote, but there seemed to be a probability that they could be used economically in the Colonies themselves, where they might prove to be a valuable aid to colonial development. The Mission was in charge of Monsieur Charles Roux, who has devoted many years to a study of these problems of national fuels, and he left for Africa with two cars fitted with special carburetters that would enable him to run on any locally produced oil available along the route.

In crossing the Sahara Desert one of the cars was put permanently out of action by the breaking of a piston-rod. The second car subsequently broke down, leaving the members of the Mission stranded in the desert for some days until they were discovered and rescued by a search party. The belief that motor cars can be employed satisfactorily for desert transport does not seem justified, in view of the special difficulties they have to encounter, through the infiltration of sand into minute interstices, the hard work put upon the engine when the car sinks in sand, and the destructive jolting when traversing the dry rocky beds of rivers. It is declared that an engine requires to be overhauled after each crossing of the desert. Desert transport offers special problems for mechanical traction, and it is not impossible that eventually a solution of them may be found.

A first examination of the conditions under which fuel oil can be produced commercially in the Colonies reveals the fact that along the coastal belt the cheapness of imported mineral oils and the high cost of oleaginous vegetable products, which are grown for export, preclude the use of vegetable oils in competition with petrol. These conditions undergo a complete change about 350 miles from the West Coast, where vegetable products have little commercial value and the cost of mineral oils is increased considerably by transport. There still remains the acidity of vegetable oils, which can only be neutralised at some cost. Raw oils from the filter press need expensive treatment. The catalytic method of dissociating the constituents of vegetable oils has not passed much beyond the laboratory stage because the cost is too high. The Charles Roux Mission had therefore to pursue research in a new direction, and ascertain what could be done in the way of low-temperature carbonisation and distillation of a number of oleaginous products in the hope of obtaining a satisfactory composite fuel. Experiments were carried out at Bamako, on the Niger, with rudimentary apparatus made on the spot. Finally, the five following products were selected—karité, ground nuts, castor plants, kapok, and cotton seeds. With a carbonising plant consisting of an oven in which a petrol drum, containing the five products in equal proportions, was partially rotated on a tube, perforated inside the drum, and terminating in a scrubber formed of a locomotive chimney closed at each end and receiving a spray of water from a perforated nozzle, it is reported that, with a temperature of 400 deg. Cent., the result was 25 per cent. oil and 20 to 24 per cent. charcoal. The raw oil was then subjected to a first distillation, which produced 5 per cent. water, 10 per cent. petrol of 750 density, 40 per cent. gas oil, 35 per cent. fuel oil, 5 per cent. coke, and 5 per cent. lost gases. Deducting from the 300 kilos. of products obtained the 30 kilos. of petrol and the coke, water, and lost gases, there remained 225 kilos. for a second distillation, which produced 5 per cent. water, 10 per cent. petrol, 30 per cent. gas oil, 50 per cent. fuel oil, and 5 per cent. coke and lost gases. In a general way, it is stated that 1 ton of oleaginous products provides 250 litres of liquid fuel and 250 kilos. of charcoal.

The gas oil was tested on two Bolinder engines belonging to the Société de Bamako, one of 5 horse-power driving a dynamo for electric lighting, and another of 50 horse-power installed on a tug running on the river Niger. In both cases the results as regards consumption and energy developed are stated to have been about the same as with mineral gas oil. A test of cotton seed oil from the filter press in the smaller engine resulted in the power developed

dropping 50 per cent. The satisfactory character of the experiments with the vegetable gas oil is testified by the Société de Bamako. They seem to show that the low-temperature carbonisation of a number of oleaginous products, which combine to produce a more stable fuel than when taken separately, offers possibilities in tropical territories where the raw material is available at low cost and where the cost of mineral oils is raised unduly by transport, or where evaporation adds to the onerous charges upon users of petrol. It is suggested that cheap low-temperature carbonisation and distilling plants can be installed all over territories outside the radius of mineral oil supplies in order to provide energy for plantations and fuel for motor transport. There is also a prospect of alcohol being used in conjunction with the lighter products of vegetable oils, for on the sisal plantations in the French Sudan the production of that spirit is increasing considerably.

The work of the Charles Roux Mission was purely experimental, but the results obtained appear to reveal a new line of research in the production of colonial oil fuels.

Internal Transport in Workshops.

THERE has recently been introduced at the St. Helens Junction Sheet Depôt of the L.M.S. Railway a "Lodemor" petrol-driven elevating platform truck, manufactured by the Laycock Engineering Company, Sheffield, and illustrated herewith. The elevating platform type of truck was selected because it is specially designed for working in conjunction with large numbers of loose platforms or stillages, a feature which enhances its value for sheet factory work. At the St. Helens Junction depôt there are running lines through all the shops. Wagons containing defective sheets received from the Traffic Department are unloaded in front of the examination berths. The sheets are then passed over the examination rollers, and marked out for repairs by the examiners. Before the introduction of the truck, the sheets, after examination, were placed in stacks by the examiners. They were then loaded on to hand trucks by sheet porters, hauled to the repair shop, and unloaded on to fixed stillages alongside the repairing floors. Sheets which, after repair, required redressing, were again loaded on to hand trucks by the porters, hauled to the dressing shop, and unloaded there to be prepared for the dressing machine. The petrol truck, working in conjunction with the loose stillages, has eliminated the double handling and man-haulage of the sheets, as well as the second double handling and haulage of repaired sheets which require redressing. The economy in time and labour cost is considerable, for over 200,000 sheets are dealt with annually at the depôt.

The loose stillages used in conjunction with the truck are wooden platforms, built on a steel frame with four legs. A number of these stillages are placed alongside the examination berths. After examination, the sheets are stacked direct on to the stillages by the examiners. Fifteen sheets, representing a load of approximately 15 cwt., can be accommodated on each stillage. The loaded stillages are taken by the truck to the repair shop and lowered into positions alongside the repairing floors, and the sheets can be taken from the stillages, as required by the sheet repairers themselves. Empty stillages are placed in convenient positions in the repair shop for the reception of repaired sheets which require to be redressed. These sheets are loaded direct on to the stillages by the repairers, and the stillages, when loaded, are taken by the truck to the dressing shop.

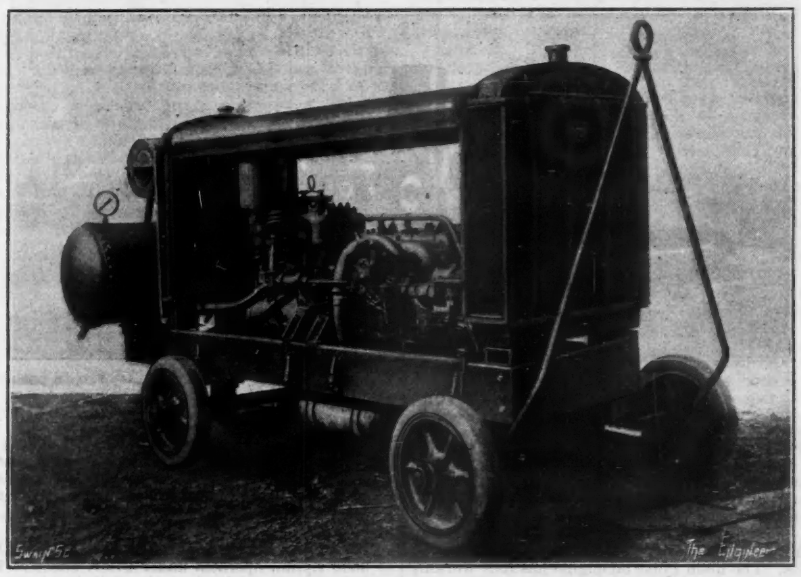
The increased speed of the transport not only enables the needs of the repair shop to be met by the truck, but the truck is available for all the general internal transport work of the department. At the St. Helens Junction depôt it is necessary to haul heavy tanks, containing sheets which have been dressed from the dressing machine to one of the drying shops, which is a distance of over 300 yards. These tanks, which are built on trollies, weigh, when loaded, about 2 tons, and require four men to haul them. This task is within the capacity of the truck, and it has been possible to cut out a very laborious method of transport by its use.

The engine of the truck is of 9·86 H.P., and is of the twin-cylinder air-cooled four-stroke type. The maximum power developed by the engine is 25 B.H.P. The carburetter is operated by a twist-grip control on the steering tiller. A kick starter is provided, while an exhaust valve lift lever is arranged conveniently to the driver's hand. The truck has a rear axle drive, with differential, and is fitted with a two-speed gear-box, which provides two speeds forward and one in reverse. The elevation of the platform is carried out by means of a secondary gear-box, bolted to the main change-speed clutch and gear-box. This secondary gear-box, which has an overall reduction of 1000 to 1, transforms the torque developed by the engine, so as to give the requisite amount of effort necessary for elevating the platform when loaded. The secondary gear-box drives two slowly rotating cranks, which, by means of connecting-rods, are coupled to a parallel motion consisting of bell crank levers and shafts, and which supports the steel platform by rollers at four points. A special feature of this elevating device is that it is endless. So long as the control lever of the elevating gear is depressed by the operator, the platform will continue to rise and fall, and no question of over-running of the platform at the upper or lower limits arises. The operation of elevating the platform is controled from the engine by engaging the gear lever in a particular slot in the change-speed gate.

"LODEMOR" PETROL-DRIVEN ELEVATING PLATFORM TRUCK

A Portable Air Compressor.

THE portable air compressor illustrated in the accompanying engraving and supplied by the Lead Wool Company, Ltd., of Snodland, Kent, is chiefly of interest from the fact that the compressor and engine are almost identical in design. The engine is a Ford industrial, and a second Ford engine fitted with a specially designed air compressor head and with suitable plate type automatic air valves substituted for its poppet valves is utilised as the compressor. The arrangement has the very considerable advantage that spare parts or replacements for either engine or compressor may be obtained from any Ford dealer. The piston displacement of the compressor is 115 cubic feet of free air per minute, and the set is suitable for compression up to 100 lb. per square inch. Both engine and compressor have four cylinders and there is an independent radiator for each. Further details may be seen by reference to the engraving. Without, it is claimed, sacrificing strength in any way the weight of the complete machine has been kept as low as 20 cwt. Its overall dimensions are 8ft. 9in. long by 4ft. wide over the wheels and 4ft. 6in. high.

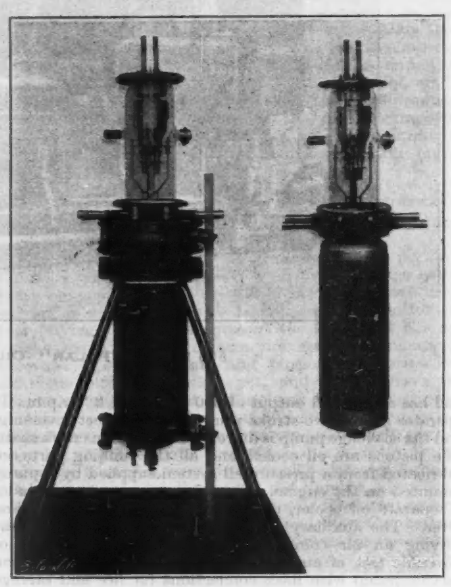


PORTABLE AIR COMPRESSOR

New B.B.C. High-Power Transmitter.

THE British Broadcasting Corporation has placed an order with the Marconi Company for a high-power broadcasting transmitter, to be installed in the new B.B.C. station which is to take the place of the Daventry long-wave station. The transmitter has been designed by the Marconi Company in close co-operation with the engineers of the B.B.C., and will incorporate some interesting features, including a new system of modulation, known as "series modulation," and high-power valves capable of dealing with very large inputs. The power rating of the station will be 100 kilowatts unmodulated carrier energy, and modulation up to 90 per cent. will be possible.

The complete transmitter will consist of five aluminium units, with glass doors, placed in line. The panels are to be sprayed with grey cellulose lacquer set in highly polished aluminium borders, with a control desk of a similar finish in front of the units, the whole equipment presenting a simple, but striking appearance. The first unit will contain the constant frequency drive to keep the station accurately on its wave length, consistent with the stringent international regulations, while the second unit will comprise the modulator and the modulated amplifier. The modulator is to be fitted with four Marconi water-cooled valves operating with an input of 50 kilowatts, and the modulated amplifier with four water-cooled Marconi valves of a different type. The output of this stage will be 20 kilowatts, delivered direct into the final power stage at an efficiency of 65 per cent. The high-tension voltage applied to the modulator and modulated amplifier in series will be from 18,000 to 20,000 volts.



WATER-COOLED WIRELESS VALVE

The third and fifth units together will comprise the final power stage, and each will contain three Marconi water-cooled valves operating at 18,000 to 20,000 volts on the anodes, one valve in each stage serving as a spare. The fourth unit will contain the main oscillatory circuit,

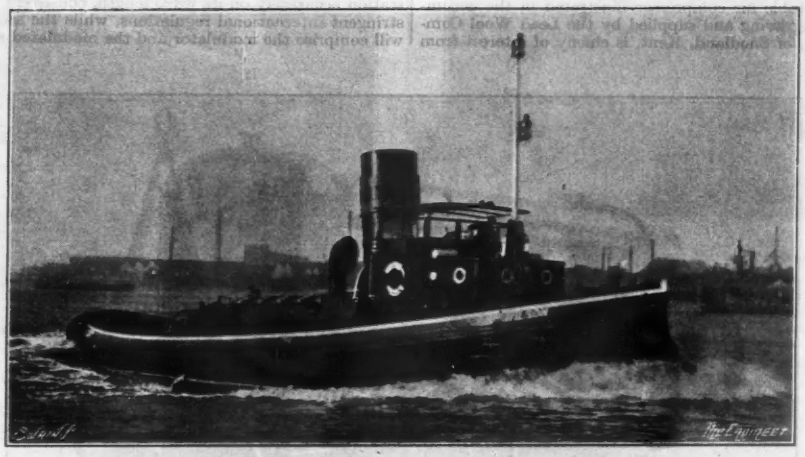
capable of dealing with the heavy currents generated by the last power stage.

The water-cooled valve shown in the accompanying illustration and referred to above is one of the latest Marconi high-power transmitting valves. On telegraphic loads it can be worked with an input of 500 kilowatts, and is capable of withstanding a continuous anode dissipation of 150 kilowatts. On telephony with an input of 150 kilowatts, at an efficiency of 33⅓ per cent., the valve is capable of delivering an unmodulated carrier energy of 50 kilowatts. The filaments of these valves operate at about 32 volts at 460 ampères.

In the new B.B.C. station each valve will have its own lighting dynamo with a field regulator, thus permitting independent and accurate adjustment of the required filament voltages. Moreover, if a valve filament should fail during operation, no rise in filament voltage will occur on the remaining valves, as might be the case if all the valves were connected in parallel with one machine.

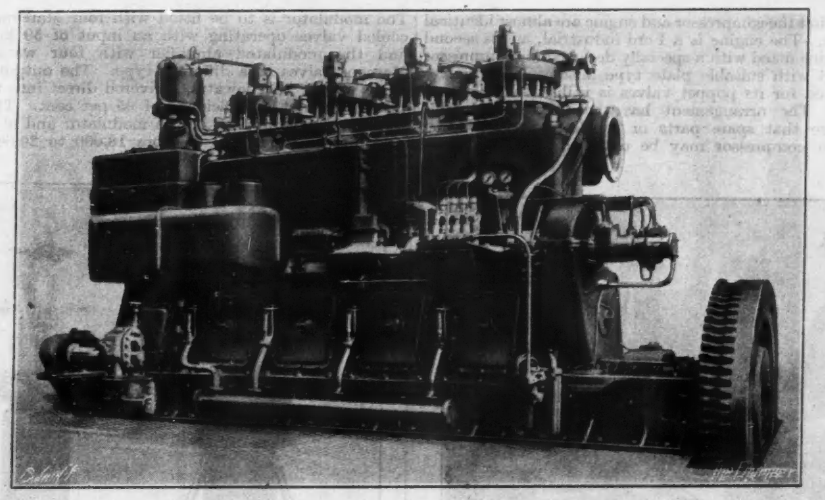
The Motor Tug John Wilson.

THE accompanying illustrations show the motor tug "John Wilson," which was recently placed in commission on the Thames, and her 500 B.H.P. Polar propelling engine. The tug, which was built by Humphrey and Gray



THAMES MOTOR TUG JOHN WILSON

(Lighterage), Ltd., at the firm's Point Wharf, East Greenwich, and engined by the Atlas-Diesel Company, Ltd., of London, is noteworthy as being one of the largest tugs engaged on Thames towage work. She has a specially high-class finish, and very comfortable accommodation for the crew. With a length of 81ft. 5in. overall, a beam of 20ft. 6in., a depth of 8ft. 1in., she has a gross register of 83·7 tons. The main Polar oil engine has four working cylinders, each 340 mm. bore with a stroke of 570 mm.,



500 B.H.P. "POLAR" OIL ENGINE FOR MOTOR TUG

and has a designed output of 500 B.H.P. at 220 r.p.m. It operates on the two-stroke principle with direct reversing, and the scavenge pump is driven from the main crank shaft. The pistons are oil cooled, and all the running parts are lubricated from a pressure oil system supplied by a pump mounted on the engine. The lubricating system includes a separate oil cooler, duplex oil fillers, and a streamline filter. The auxiliary engine is an 18 B.H.P. Polar unit driving an air compressor with a designed output of 25 cubic feet of air per minute, and a Truslove general service pump with deck connections for fire and salvage purposes. Current for lighting is furnished by a 2½-kW Bolinder oil engine-driven generator set. A feature of the hull fittings is the extensive use which has been made of chromium-plated parts, while the crew accommodation is noteworthy in that both hot and cold running water is supplied to the cabins, and hot water radiators are provided in the fore cabin, the wheel house, and the engine-room.

During the trials, which were carried out on the Long Reach measured mile on the Thames, a tow rope pull of about 6 tons was registered when towing four coal barges loaded to about 920 tons, and a speed of about 4·6 knots was recorded against the tide. At full tow the engine speed was just 220 r.p.m.—that is, the normal speed with the fuel lever at full load setting—showing that the full rated output of the engine was being absorbed by the special propeller designed and supplied by the Atlas Diesel Company, Ltd. When running free with the engine speed kept normal by reducing the amount of fuel the speed of the tug was about 11 knots. Manœuvring was carried out easily and rapidly, complete reversals of the machinery being effected in about five seconds. Three air receivers are provided, each of which is dimensioned to give thirty to forty manœuvres without recharging.

Gas Engine Started by a Water Turbine.

EMERGENCY electric lighting is now required by an increasing number of American cities by ordinance, and in others by a State law. In the event of a mains failure, a solenoid actuates a starting device which throws the auxiliary source of power into operation.

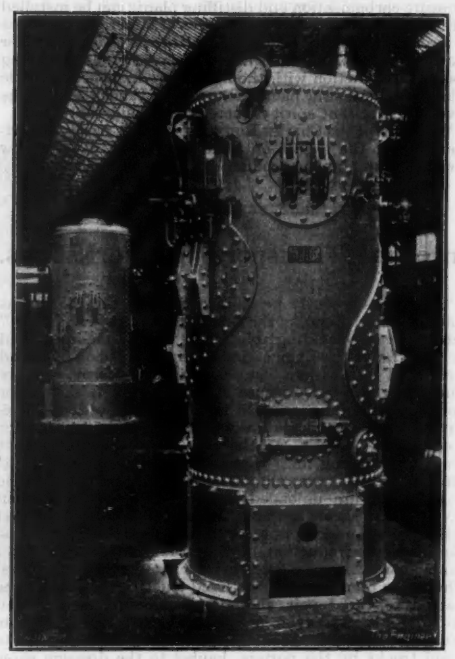
The new Berks County Court House, in Reading, Penne., reputed to have cost 20,000,000 dollars to finish, has an interesting emergency lighting power plant in that a small spiral case-type water turbine, taking its pressure supply from 25,000-gallon tanks on the roof of the building, twenty-three storeys above, "cranks" a gas engine-main unit.

The turbine is of the Francis type, of 8 H.P. output at 3600 r.p.m., operates under 275ft. effective head, and with its connected load attains full speed in about two seconds after the failure of normal electric power. As soon as the reserve generator is furnishing current at about 200 volts, a D.C. solenoid closes the valve of the turbine.

Water Heating and Steam Raising Plant at Belfast.

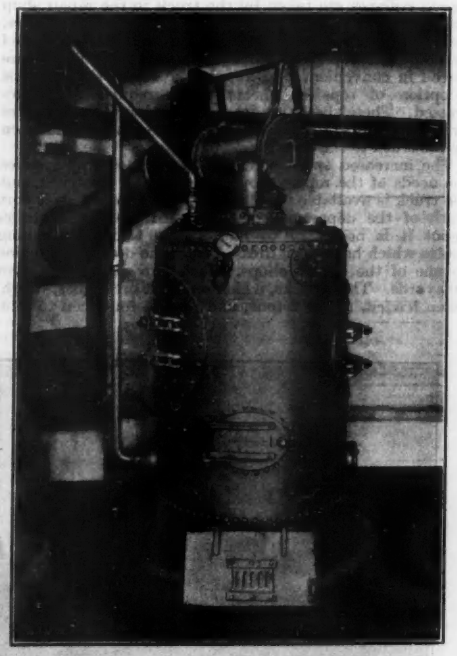
THE boilers installed at the works of Robinson and Cleavers at Belfast consist of two of the latest type of patented high-duty, oil-fired "Spencer-Hopwood" units and one patented "Spencer-Hopwood" water-heating unit, which latter unit has a special grate arranged for burning either coke breeze or waste material, such as packing cases, paper, and other shop refuse which collects in an establishment of this magnitude, and which is inclined to be a serious embarrassment if not dealt with promptly and continuously. The steam boilers illustrated herewith supply steam to the laundry on the top floor of the building, and also to the staff kitchens and for heating the entire building. The steam demand is in the neighbourhood of 2500 lb. per hour, and the hot water requirements are 5000 gallons per hour, at 190 deg. Fah.

The high-duty boilers are only 3ft. 9in. diameter by 9ft. 6in. high, and are fired with a "Filma" oil burner equipment. Each boiler during the acceptance test



HIGH-DUTY OIL-FIRED SPENCER-HOPWOOD BOILERS

gave 1700 lb. of steam per hour with feed water at 170 deg. Fah., the overall efficiency being 74 per cent., rising to a maximum of 80 per cent. The water-heating boiler, which is also illustrated, is a standard "Spencer-Hopwood" water heater, 3ft. 9in. diameter by 5ft. 10in. high, fitted with a special grate and damper arrangement on the ashpit and in the chimney, by the use of which it is possible to bank the fire at night with coke breeze and still ensure an ample supply of hot water for immediate use for the early morning start. During the day



WATER-HEATING SPENCER-HOPWOOD BOILER

the supply of refuse is generally sufficient to maintain an adequate output of hot water, but in the event of a temporary shortage of this refuse, coke breeze can be used to augment the supply. The boilers and the water heater were supplied by Sir W. G. Armstrong, Whitworth and Co. (Engineers), Ltd., of Scotswood Works, Newcastle-upon-Tyne.

DURING a lecture on Accident Prevention in Industry, Mr. E. J. Fox, of the Stanton Ironworks Company, eulogised the bowler hat as a protection for the head, and said that they were largely worn in his works. The old tin hat of the well sinker is, of course, familiar, but we think that the matter was perhaps best put by a ship-building engineer when he said that impact on the top of a bowler gave one time to get out of the way before that impact reached the head, whereas with a cap the two were simultaneous.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Confidence Increases.

CONFIDENCE in the future of trade in the Midlands and Staffordshire has extended as a result of last week's quarterly meeting in Birmingham, and of the stimulus derived from the returns of trade alike in December and the year 1932 as a whole. There was no significant development in regard to consumptive demand for iron and steel, or in selling prices of these materials at the quarterly gathering. The attitude adopted both by producers and users was one of ardent hopefulness and cheer, but their activities were held in check by a caution grown strong as a result of the long spell of industrial depression. Prophecies of improvement have so seldom during the past year been fulfilled that industrialists are naturally scared of over-optimism and of really free buying. Inquiries in circulation certainly suggest that there are definite prospects of a larger consumptive demand in the near future; in fact, it would be fairly safe to say that in a number of branches more material is being used up week by week so far this year than was the case during last quarter. The increased material required by district engineering and manufacturing works is small, and makes little effect on the market each week, but if the present improving tendency is maintained, there should be at the end of the month a positive amendment in consumption when compared with that at the year's opening. Though foreign iron and steelmasters have not yet given up their efforts to hold a large section of business in the Midlands local producers are steadily making headway, and there are good grounds for hoping that as industrial activity extends the proportion of native iron and steel worked up will be greater. A large amount of the Continental material bought last year at cheap rates has now been absorbed, but Birmingham merchants report that little new business is being passed to overseas firms. On the other hand, Midland makers admit their sales are becoming larger. Last week's meeting was encouraging, and there has not been any falling away, either in the market tone or in the volume of business during the current week.

Perceptible Signs of Progress.

Definite evidence of improvement in the industrial situation is afforded by recent official statistics. During December exports of manufactured goods increased substantially, while imports continued to fall away, although we made greater purchases of raw material during the month. The whole return from this district's point of view was gratifying. Production of iron and steel during December showed an improving tendency and the number of furnaces in blast increased by one. Output of pig iron, although it was below the level of the corresponding month twelve months earlier, was well in advance of the previous month's figures. In the case of steel ingots and castings, while the output was below that of November, it was in advance of that of December, 1931. The trade returns for 1932 showed imports and exports to be lower than in the previous year, but the adverse balance of trade has been substantially reduced, namely, from £408,976,000 to £287,081,000. This is surely an achievement to be proud of. Moreover, in a world of shrinking trade, Britain has regained her leading position as an exporting country. These evidences, taken in conjunction with the better reports so far this year from industrial centres, justify us in thinking with Mr. William Preston, a Wednesbury manufacturer, that "prosperity is coming to us, and we have got to the end of the long lane of depression."

Buying British.

Trade lost for some years to the foreigner is being recovered. Colonel C. Hatton, at a recent meeting, stated that he was connected with a business in which, for many years, they had kept their workmen together by buying foreign sheets and angles. There had been a great difference between the prices of the English and foreign article, but to-day they were buying English plates and angle iron at within a few shillings of the price of the foreign. If they could go a little further and eliminate that small difference, it would mean a great thing. If they used their own iron ore, puddling furnaces and rolling mills would do better, and there would be an improvement in the coal industry.

Steel.

What change there is on the week in the steel trade has been brought about by the disturbance of the market by the movements of foreign competitors. In the Midlands and Staffordshire there is not the same growing activity in the finished steel department as is reported in other areas. Midland makers are, however, hoping that the movement will spread and eventually embrace them. At present operations are of a limited character, and the tonnages in request are small. There has been a fair demand of late for steel plates for the manufacture of tanks for storage purposes. Constructional business remains very quiet. Rolling stock makers are not fully employed. Selling prices of steel are held at the Association level. Angles are £8 7s. 6d., less 15s. rebate to users of British steel only; tees, £9 7s. 6d., less 15s.; joists, £8 15s., less 22s. 6d.; ship, bridge and tank plates, £8 17s. 6d., less 15s. The demand for boiler plates has fallen away, and values which are not controlled have fallen also. This week some makers have accepted £8 5s., per ton, a reduction of 2s. 6d. on recent minimum quotations. In the half-products branch of the market local makers are marking time pending the development of the Continental situation. Staffordshire re-rollers and makers of billets are maintaining the selling prices lately current. Efforts are being made in the billet branch to rope in unassociated firms and to strengthen generally the price position. For some little time past supplies of billets have been procurable at minimum rates, irrespective of tonnage. Associated suppliers have, of course, adhered to the graduated scale formally agreed upon. All-British small bars are quoted £7 per ton upwards; small re-rolled bars, £6 15s.; soft billets, £4 17s. 6d. to £5 7s. 6d.; sheet bars, £4 17s. 6d. District steelmasters hope Continental prices will continue to appreciate. At the moment, business is not too brisk, but if the present tendency of prices continues, consumers are likely to come into the market more freely.

Raw Iron.

Demand for pig iron is very much on a level with present output from Midland furnaces. There are still considerable stocks in the hands of some smelters, and these will have to be liquidated before the rate of production at the furnaces is increased. It is reported that a number of customers in the foundry world would be prepared to make forward arrangements for supplies covering an extended period. Furnacemen are disinclined to enter into these commitments as they consider an increase in iron prices in the near future to be more than probable. It is asserted that costs of production are very unlikely to fall, but there is a possibility of an increase and a probability of an extension of demand. At date values of Midland brands are very firm. Northamptonshire No. 3 foundry commands £3 2s. 6d. per ton, delivered to stations in the Black Country, while Derbyshire and North Staffordshire similar grade iron makes £3 6s. Quotations for forge sorts are £2 17s. 6d. and £3 1s. respectively. The quarterly meeting last week did not add any great tonnage to smelters' order books, and was held by some to be rather disappointing in this respect.

Manufactured Iron.

In the Staffordshire finished iron industry there is scarcely any alteration in conditions on the week; indeed, the position is much the same as it was three months ago. Ironmasters consider themselves fortunate to have forward business on the books, since most of the transactions are of a hand-to-mouth character. Rolling programmes have to be arranged day by day, as specifications are received. There are those in the industry who are still hopeful that before long there will be a definite rise in the trade tide. Makers of common bars have possibly the best chances in this respect, in that should French and Belgian prices advance a little further, Staffordshire ironmasters may once again be called upon to supply the needs of Black Country makers of bolt and nuts and of fencing. Iron prices ruling this week in Birmingham were; Marked bars, £12 per ton at makers' works; Crown bars, £8 12s. 6d. upwards, delivered; common bars, £7 15s. upwards; iron tube strip, £10 7s. 6d. to £10 10s.

Galvanised Sheets.

Galvanised sheet mills in this area are moderately engaged, alike on home and export account. Indian business has not developed much as yet, but a good deal is anticipated from the general agreement recently arrived at. There has been no alteration in prices during the past week, quotations being based on £10 10s. f.o.b. and £11 15s. delivered for 24-gauge galvanised corrugateds. Black sheets are £8 10s. for export, and £9 10s. upward for the home trade.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

An Engineering Trade Retrospect.

THE report for the past year of the Engineering and Metals Section of the Manchester Chamber of Commerce, presented at the annual meeting last Friday, at which Alderman F. J. West was re-elected chairman, states that engineering in Manchester has shared to the full the depression in industry generally, though signs are not wanting that the outlook for 1933 is brighter than it was a year ago. Whether this is a natural reaction from the exaggerated ideas of economy which then prevailed, or whether it betokens a genuine move forward, the report states, it is too early to say. The experience of machine tool makers during 1932 has, to some extent, depended upon the type of production in which they have been engaged. Export business, apart from that with Russia, has become steadily worse. In addition to the difficulties brought about by increased tariffs and currency restrictions, shippers have also been faced in certain important markets with import quotas which have made it exceedingly difficult, and, in some cases, almost impossible, to do business. The prospects of an improvement in the demand for machine tools from abroad are, generally speaking, unsatisfactory. They are bound up very largely with the removal of the restrictions now in force, whilst they are, of course, also largely dependent upon a return to more normal world conditions. It is as yet too early to reach any definite conclusions as to the effect on the machine tool industry of the domestic tariff, although it is reasonable to anticipate an improvement in the home trade.

Electrical and Gas Engineering.

Discussing the position in the electrical engineering industry, the report points out that the continued extension of the distribution of a standardised current in this country has enabled industrial motor manufacturers to standardise and stock their products with greater security and advantage in cost of manufacture, which, in turn, has been of benefit to consumers generally. The industry has, nevertheless, suffered through the restricted purchasing of the allied and consuming industries, although the situation has been temporarily alleviated by the exchange and reinstallation of motors in consequence of the "grid" change-over. Large contracts have been secured, or carried out, during the past year, including a complete new power station in South America, large turbo-generators for London and Rhodesia, and other works of a comparable nature for Russia and other Continental countries. Manchester and district has been successful in obtaining its fair share of what business has been placed. On the question of gas engineering, it is stated that gasworks extensions at home have not been important, either in number or magnitude, but there are signs that the exaggerated ideas of economy, as applied to revenue-earning undertakings, are being revised and some encouraging inquiries have been received. Foreign inquiries, also, are showing signs of revival; two large contracts for gasworks extensions have been provisionally booked in the district, and others are pending, chiefly from the Continent.

Textile Machinery and Locomotives.

Makers of textile machinery have not enjoyed a good year on account of the continued small demand for their products. The increased activity which has occurred both in the cotton and woollen textile industries has not been sufficient to cause any marked extension of demand, with the result that conditions have remained quiet. The close of the year was notable for the introduction of further steps towards rationalisation of production and plant by leading makers. The immediate outlook in this branch, whilst slightly better than a year ago, still shows little genuine reason for optimism. Referring, in conclusion, to the locomotive industry, the report states that world conditions have again left their mark, and 1932 has been a very unsatisfactory year for locomotive builders. Export trade has shown a marked decline, and the contraction of demand has been experienced in all markets, particularly India and the Argentine. Unfortunately, the industry's prospects are not of the best. It can hardly be anticipated that schemes for considerable development will mature until the general prospects of world trade improve.

Non-ferrous Metals.

Apart from lead, which has recovered some of the ground lost in the previous week, all sections of the non-ferrous metals market since last report have further weakened, the declines in the case of both copper and tin being rather substantial. Buying interest in copper has been quiet and only a moderate business has been done in refined descriptions, as well as in standard brands. Compared with a week ago, values of the latter are lower on balance to the extent of about 12s. 6d. per ton. With regard to tin, at the moment of writing holders of the metal are adopting a more reserved attitude and the undertone in consequence is steadier than it has been of late. A moderate demand has been experienced, with prices showing a reduction of £1 2s. 6d. per ton. A fair amount of inquiry has been reported in the lead section and with the advance of about 5s. per ton on balance half of the loss experienced in the previous week has been made good. Spelter is roughly 2s. 6d. per ton cheaper, and at the moment the undertone is less satisfactory than it had been up to a few weeks ago. Only a moderate movement of the metal has been reported.

Iron and Steel.

The demand for iron and steel products on the Lancashire markets makes little headway. In foundry pig iron sellers are booking few contract orders of any consequence, and whilst here and there speciality foundries are not unsatisfactorily engaged, neither in the heavy branches nor among jobbing foundries do order books show any improvement. Quotations, however, are steady on the basis of 67s. per ton for Staffordshire and Derbyshire No. 3, 65s. 6d. for Northants, 62s. for Derbyshire forge, about 82s. for Scottish No. 3, and 80s. 6d. for West Coast hematite, including delivery to works in the Manchester area in each case. The bar iron trade is quiet, but values are maintained at £9 15s. for Lancashire Crown bars and £10 5s. for best quality material. In the steel section there is general complaint regarding the position of constructional engineers, few of whom are able to maintain even a moderate rate of activity. Locomotive builders and boilermakers are also short of work. Alloy steel makers are booking a moderate business, and the improvement among forge makers reported towards the end of the year keeps up fairly well. Steel prices, generally, are on much the same levels as before so far as the home-produced materials are concerned, but in the case of imported products renewed firmness has been witnessed within the past few days and current values are appreciably higher than they were a week ago.

BARROW-IN-FURNESS.

Hematite.

The improved tone in the hematite pig iron market is maintained, and is practically due to the better home demand. For some weeks deliveries have been heavier, and there seems to be a general inclination for freer buying. Up to the present the Continent has not bought much, although there are small shipments at intervals. To all intents and purposes, America has not come into the market yet, and neither have the Dominions and Colonies. The local steel departments are taking a good share of iron and stocks generally are inclined to come down. The iron ore trade has plenty of room for improvement, but business is a little better. Native ore is easy in view of the small number of furnaces in blast, not only locally, but in the country; but there are hopes of a bigger outside demand. The steel market remains quiet, but both the Barrow and West Cumberland mills are engaged at present. Fresh orders for rails would be very welcome.

Shipbuilding.

Work is proceeding rapidly on the "Queen of Bermuda," which has to be completed in the next few weeks. A big squad of men is engaged upon her night and day. There are rumours of further shipbuilding contracts for Barrow, but it is too early to talk yet. Perhaps more will be known in the course of the next two months or so.

SHEFFIELD.

(From our own Correspondent.)

The General Position.

THERE is no new feature to report in the heavy trade situation of Sheffield. Although confidence in a revival as the year advances is widely felt, and there is said to be much business in prospect, actual evidence of progress is not to be found yet. Firms have been in no hurry to resume operations after the Christmas stoppage, but the bulk of the suspended workmen returned last week, and others have gone back this week. There is more activity in the scrap market, which is a good sign, but output at the open-hearth furnaces shows no increase. Heavy manufacturing is quiet, except in the hollow-forged drum department, the call for shipbuilding and railway requirements remaining at the previous low level.

The New Cunarder.

Although there is no news as to any decision to resume work on the great new 70,000-ton Cunarder, at present partially completed at John Brown and Co.'s yard at Clydebank, it is interesting to know that Sheffield is still doing some work on the original part of the contract. A party of university students from Cape Town, who were in Sheffield last week, visited the works of Thos. Firth and John Brown, Ltd., where they saw in progress the machining of the propeller shaft for the great vessel. As previously reported, Sheffield did a great deal of work for the ship before the building was suspended, and most of the forgings were sent to Scotland some time ago. There are still, however, a few jobs to be finished off here, and the propeller shaft is one of them.

Railway Work.

The departments devoted to the production of railway axles, tires, and springs continue to be in want of work, the present orders not sufficing to employ them up to capacity. It has recently been reported that the home railway companies are placing contracts on a rather larger scale than of late, but a policy of economy is still being pursued. There is better news for Doncaster, where, principally on account of a substantial order for the building of new carriages, the staff of the London and North-Eastern Railway Company's works is to be increased by 200 men. The company's constructional programme was curtailed last year, and it is understood that arrears of stock replacements are now being carried out. It is hoped that the orders in the carriage department will be followed by others in various departments. A five-day week is maintained at the works, but it is understood that the Crimpsall shops, one of the largest departments, employing more than 400 men, are likely to resume a full working week shortly. The company has decided to make a bold bid to recapture some of the summer traffic which has passed to the roads. A number of new engines are to be built, and it is regarded as certain that the steel industries of Sheffield will benefit.

The Lighter Side.

The demands of the automobile builders keep up well, and provide a large amount of work for Sheffield in stampings, pressings, and special steels. The year has started well in the stainless steel branch, and further developments are in hand. A number of special lines of steel goods, which have been actively employed during the last six or twelve months, are maintaining their position. One of these is steel strip, both cold and hot rolled, which is used in great quantities for safety razor blades, box strapping, and many other purposes. Another is permanent magnets, for wireless loud speakers, the sale of which, aided by new processes of manufacture that have enabled prices to be lowered, is going up by leaps and bounds. Several sections of the tool trade are well situated for work, and the average throughout this branch is fair. While exports of steel and special manufactures are not good, they can be regarded as fairly satisfactory, in view of the many restrictions on such trade which are in force in nearly every country of the world. The country's export of special steels—perhaps the most expensive of Sheffield's products—last year reached a value of £351,588, as compared with £293,818 in 1931, and the item is still growing. Imports, on the other hand, fell last year by more than a half.

Shoe and Stay Tags: A Correction.

In your last issue I stated that Samuel Fox and Co., Ltd., of Stocksbridge, a branch of the United Steel Companies, Ltd., is undertaking the manufacture of shoe and stay tags. I am now informed that this statement is inaccurate, and that the firm has no intention whatever of entering this class of business.

Tipped Tool Progress.

An important development of the Sheffield tool trade during the last few years has been the adoption of the practice of "tipping" tools. Instead of making a tool entirely of the highest grade of steel, that quality is used only for the working tip, the shank being made of cheaper material. This innovation, while reducing the quantity of high grade steel called for, has enabled the use of the finest quality tools to be greatly extended. Old Park Forge, Ltd., Neepsend Tool Works, Sheffield, has just introduced, and provisionally protected, a new tipping process. The general practice formerly was to braze small plates of high-speed steel, &c., on to the body of the tool, while of late, owing to this method not being entirely satisfactory, butt welding a solid end on to the body of the tool has been carried out. By the process now introduced by Old Park Forge, Ltd., the working part is deposited on the body by fusion and deposition occurs in a liquid or semi-liquid condition.

This process has greatly widened the field of application of the process. By the older methods it was practicaliy confined to turning and similar tools; but now it has been successfully applied to drills, boring bits, cutting-out tools, punches and dies, cold and hot saws, shear blades, picks, percussive tools, wortle plates, and many other classes of tools. It is claimed that replacements should rarely be necessary, as the working parts can be renewed at a very small cost. In a test recently carried out at the Sheffield Testing Works, an ordinary 1¼in. diameter carbon steel twist drill, tipped with special material by this method, penetrated through 8ft. 3in. of tire steel containing 0·7 per cent. carbon, 0·7 per cent. manganese, and was run at a speed increasing from 165 to 270 revolutions per minute, whilst the penetration for the latter part of the test was at the rate of 5·91in. per minute. The drill was not reground from start to finish, and was still cutting when the test was stopped. The improvement enables a very considerable saving in tool costs to be effected, both in initial outlay and in maintenance.

Good Orders for Stove Grates.

The trade in stove grates is in a healthy state. Several manufacturers, both in Sheffield and Rotherham, are able to report satisfactory order books, and one firm in the latter town states that it has not had so much work in hand in January for at least fifteen years. Gummers, Ltd., of Rotherham, has secured a repeat order for fittings for the Royal Palace at Brussels.

Bridging the Humber.

A special committee of Hull Corporation has adopted an amended scheme for a bridge over the Humber, which is to be submitted to the Council. The original estimated cost of the bridge was £1,789,330, but under the new proposals a saving of £400,000 will be effected by using material left over from the Sydney Harbour Bridge, reducing the number of piers to support the bridge from seventeen to seven, and adopting a new financial plan, by which the annual loan charges will be £85,000 instead of £134,000.

Higher Cutlery Exports.

In the table cutlery and electro-plate trades January is usually quiet, and this condition is being experienced at present. Advantage is being taken of this to renovate factories and plants. The outlook for these branches is not considered favourable. A feature of last year's trade was the extensive sale of pewter goods, and sterling silver ware also enjoyed a very good demand, some people buying it as an investment owing to the very low price of silver. Exports of cutlery last year amounted to a value of £800,675, which was much better than the £642,372 of 1931, but below the £882,493 of 1930. Imports, which in 1930 were £488,969 and in 1931 £768,342, fell to £159,135. Re-exports amounted to £36,502 in 1932, as compared with £137,661 in 1931 and £120,566 in 1930. The exports for 1931 showed declines in knives and scissors, but a considerable gain in safety razors and blades, the figures for which amounted to £468,000, or more than half the total.

NORTH OF ENGLAND.

(From our own Correspondent.)

Welded Ship Order.

SWAN, HUNTER AND WIGHAM RICHARDSON, Ltd., Wallsend, have booked the first shipbuilding order on the Tyne this year. It is for an oil-carrying barge, 180ft. in length and of about 1000 tons capacity, for Canadian owners. Although the vessel is a small one, it is interesting, because it will be constructed by welding, which takes the place of riveting. During the last year or so considerable interest has been taken in shipbuilding circles in this system of construction, and Swan, Hunter and Wigham Richardson, Ltd., have already introduced it into their yards to a certain extent. The barge, however, will be the first vessel to be constructed entirely on the principle on the Tyne. A class for the instruction of the shipyard men in welding has been carried on in Newcastle for some time, and it is claimed that the system is quickly learnt.

Cleveland Iron Trade.

There is a much quieter tone in the Cleveland pig iron trade, although the atmosphere of hopefulness still prevails. A fair volume of orders has been booked recently, however, and output is being fully taken up. It is expected that the present level of production will be maintained for some time to come, but there appears to be no prospect of more blast-furnaces being put into operation. Local consumers have not abandoned hope of lower prices, and are buying on a hand-to-mouth basis. Further sales to Scotland have been negotiated, but prices received from across the Border are very unsatisfactory. Export business is scarce. Prices to home consumers remain unchanged, No. 1 Cleveland foundry iron being 61s., No. 3 G.M.B. 58s. 6d., No. 4 foundry 57s. 6d., and No. 4 forge 57s.

Hematite Pig Iron.

Producers of East Coast hematite pig iron are hampered by heavy stocks, which are not being reduced to any great extent. Many consumers are stated to be holding off the market in the hope of reduced prices, but in some quarters there is a disposition to believe that any change will be upwards because costs of production show no signs of declining. Mixed numbers are still quoted at 59s., with No. 1 quality at 59s. 6d.

Iron-making Materials.

Business in foreign ore is virtually at a standstill, with best Rubio ore nominal at 15s. 3d. c.i.f. Tees. Market transactions in blast-furnace coke are few and small, local consumers mostly using their own makes. Sellers quote on the basis of good medium qualities at 16s. delivered to North-East Coast works.

Manufactured Iron and Steel.

The manufactured iron and steel trade is somewhat sluggish just now. The further reduction in Continental steel prices is a disturbing factor, but, so far as can be gathered, no business has this week been done in this area at the reduced rates. Orders are not numerous in the heavy sections of the industry. Constructional steel is not attracting much attention, and railway and shipbuilding specifications are scarce. A limited number of inquiries for new tonnage has been received by North-East Coast shipbuilders, and if they lead to definite contracts the steel works in the district will benefit. Prices are unchanged.

The Coal Trade.

The Northern coal trade is experiencing some difficulty in meeting present-day demands, owing to a drop in production. The influenza epidemic is still rife among miners in both Northumberland and Durham. From this cause some of the large groups of pits have had their production diminished by hundreds of tons per day. This has had the effect of keeping values very steady, but there is an impression among exporters that, directly the sickness abates, output will rise and prices will ease all round. It would not do to rely too much on that point of view, however, as so much depends on the weather. It has been a mild winter so far, but a spell of severity would make a great difference. Northumberland has more trade than ever it has known in modern times, and a visitation of frost or snow would send up the consumption so sharply that the county might be hard put to it to meet the demand. Durham is not circumstanced in quite the same way, but imports of foreign pig iron and steel having practically stopped as a result of the tariffs, the time may not be far off when much more manufacturing coal will be needed, and therein would be Durham's opportunity. Thus very steady, even strong, prices may be experienced in the next two months rather than the expected easier values.

Coal Market Conditions.

With the substantial recent bookings for best steam coals the market remains firm. Collieries report having full order books over the next few weeks. Northumberland best steams are quoted direct for early shipment at 14s. 6d., but this price might be discounted through contractors. Durham steams are also offered sparingly, and are stiffly quoted at 16s. Tyne prime descriptions are reported to be in a very favourable position, with holders steadily quoting 13s. 6d. Steam smalls, despite a substantial output, find a ready clearance at full recent prices, best Northumberland being 8s. 6d., Tyne primes 9s., Durham primes 11s., and secondary Tyne and similar brands 8s. The increased demand for gas coal is maintained, and good Durham qualities are offered in moderate volume for early shipment at 14s. 6d., with special Wear qualities at 15s. Secondary gas are on the whole quietly steady at 13s. 3d. to 13s. 6d. Coking unscreened offer freely at 12s. 6d. to 13s. 3d. The bunker trade remains active, best brands for prompt being scarce and stiffly held at 14s. 6d., while good ordinary are steady at 13s. 3d. to 13s. 6d. There is no special pressure in coke, and the demand is reacting from recent activity. Mild weather abroad and ample stocks are limiting overseas trade. Gas coke remains scarce at 18s. 6d., patent oven coke is offered freely at 15s. 3d. to 15s. 6d., and superior makes at 16s. 3d. to 16s. 6d. Coke nuts are a quieter trade at 16s. 6d. to 17s. 6d.

Old Pontoon To Go.

Swan, Hunter and Wigham Richardson, Ltd., have decided to break up the pontoon at their ship-repairing department. It is to make way for the new large graving dock, work on which has already been started by the contractors, R. McAlpine and Sons. The pontoon, which will be towed up the Tyne to the ship-breaking yard of King and Co., Ltd., has been in service for more than forty years. The structure is 300ft. in length and 70ft. in breadth.

SCOTLAND.

(From our own Correspondent.)

Trade Prospects.

THOUGH the year is yet young, and markets still more or less under the influence of the holidays, there seems some reason to anticipate an improvement of trade in the near future. Without trusting altogether to rumuors, of which there are many, there seems to be some real evidence of improvement. In some cases employment is being increased and the class of worker re-engaged would appear to indicate an anticipated improvement in the heavy industries. Many are of the opinion that the tide has turned, but the response from some of the most important industries has been very meagre so far. The decline in the Clyde shipbuilding industry has been an outstanding feature; consequently, any orders coming this way are hailed as a sign of improvement. Rumours concerning the Cunarder at Clydebank have been most persistent of late, and it is apparently anticipated that a restart on that vessel would engender the necessary confidence in others to place contracts for new tonnage to the ultimate benefit of the shipbuilding and allied trades. The first shipbuilding order placed on the Clyde this year has been received by Messrs. Scott's, of Greenock, the contract being for a passenger and cargo steamer for London owners. Expectations of an improvement in trade have so often failed to materialise that one is chary of becoming too optimistic; but, from various reports, it seems evident that in the opinion of some the tide is turning and efforts are being made in order to be ready to take full advantage of the anticipated improvement.

Steel.

It was only this week that the steel works restarted after the New Year holidays, and so far no change of importance in conditions has been reported, and the accumulation of orders over the vacation has been extremely modest. It is said, however, that inquiries are better and broader in conception. At the

moment steel-makers are better off than any other department in the matter of orders booked, and more especially in light material. Tubes are moderately specified.

Iron.

The feeling of hopefulness has penetrated to the iron trade, but so far nothing has happened to substantiate any such sentiment. Bar iron at £9 15s. home and £9 5s. per ton export is on rather a high level to prove attractive, and the same might also be said of re-rolled steel bars at £7 5s. home and £6 10s. per ton export. Likewise, there is at the moment little encouragement to increase the production of pig iron. Demands have been easily satisfied from stocks and by the output of the two furnaces still in blast augmented by the regular arrivals of iron from Calcutta. Last week 2000 tons of pig iron arrived from India.

Scrap.

There has been a little more movement in scrap of late, and prices are a shade firmer round about 37s. 6d. for heavy steel, and 47s. 6d. per ton for cast iron machinery.

Coal.

The supply of coal now assumes more normal proportions and the strength of the market is more easily gauged. Round fuels in all districts are comparatively well sold, with some extra business doing in Lothians navigation coal. Washed nuts are more freely offered and prices are inclined to weaken, except in the case of Fifeshire trebles, which maintain a very firm attitude. Aggregate shipments amounted to 228,199 tons, against 117,606 in the preceding week and 212,038 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

The Coal Trade.

RETURNS of coal and coke shipments from the G.W.R. ports in this area last week were very encouraging, as the total of 443,365 tons registered an increase of 65,165 tons upon the quantity for the preceding week and compared with 376,030 tons for the same period of last year. It must not, however, be concluded from this improved return that the general position of trade has changed so much for the better that this increase will be maintained. The fact is that the collieries were placed in a more favourable loading position last week by reason of delayed tonnage arriving, and shipments were particularly active, notably at Barry, where all berths were occupied, and at one time steamers were waiting to load. At the end of the week, however, the situation from the tonnage point of view was that there were thirty-two tipping appliances idle. As the result of arrivals over the week-end a very fair start was made on Monday last, when the dock report showed that at the ports between Newport and Barry the number of idle tipping appliances was twenty-six. Swansea and Port Talbot were more favourably placed, for one vessel was waiting at Port Talbot, while at Swansea nine were waiting for a berth. The returns of shipments this week should be fairly good, but it has to be admitted that the current demand for coals of steam quality is very quiet, and chartering operations cannot be said to have been really active of late. Apart from the inquiry for coals for prompt shipment being almost featureless, there is not much business passing in coals on contract account. The news from Spain that the Government had purchased 100,000 tons of coals already mined in the Asturias in order to relieve the desperate mining situation in that country is not expected adversely to influence Spanish requirements from South Wales, as coals of a quality superior to the native product are required for the railway and other services. Up to the time of writing, no news has come to hand of the placing of the contract for 21,000 tons of large coal for the Andaluces Railway, for which tenders from this district went in last week. Furthermore, it is of interest to note that the Norte Railway of Spain is reported to be about to enter this market for about 18,000 tons of coals. Inquiries from other directions are practically negligible, but it serves to show the competition which British coals have to face as compared with even a few years ago, when it is stated that details have now been received concerning a contract which a British foreign depôt firm has entered into for Turkish coals. It is now stated that the quantity is for 250,000 tons, consisting of one third washed beans, one third washed nuts, and one third screened large, and that shipments will be effected to Greece, Italy, and other Levant and Mediterranean ports, while it is the intention of the firm in question to establish coaling stations at Port Said, North Algeria, Oran, and Gibraltar. According to the report, the f.o.b. prices of the Turkish coals will successfully compete with British exports, especially Durham.

Traffic Returns for 1932.

The details of the sea-borne traffic at the six ports in this district under the control of the Great Western Railway Company have now been issued by the company, and, as might be expected, the figures for the year 1932 show a reduction upon those of the preceding year. Imports and exports combined came to 25,925,310 tons, as against 27,876,612 tons for 1931. When set against the figures for 1913 the falling off in trade is truly heavy, as in that year the quantity was 47,148,651 tons. It, in fact, represents a decline of nearly 50 per cent. As a matter of fact, imports last year held up fairly well, as the total was 3,412,332 tons, as against 3,968,858 tons for 1931, but on the export side the total for 1932 was 22,512,978 tons, which compared with 23,907,754 tons for the previous year. Reduced shipments of coal and coke chiefly accounted for the less favourable figures for 1932. These shipments came to 20,385,131 tons, as against 21,747,464 tons for 1931. As might be expected, all the ports show a reduction in coal and coke shipments, with the exception of Swansea and Port Talbot. In the case of Swansea shipments came to 3,584,023 tons, as compared with 3,172,668 tons for 1931, while at Port Talbot the quantity last year was 1,909,858 tons, as against 1,583,179 tons. The expansion in the demand for anthracite coals, particularly for Canada, was primarily responsible for the improvement in the shipments at these two ports. It is also interesting to note that the returns relating to the imports of iron and steel show that the total for last year was 535,191 tons, as compared with 847,778 tons for 1931.

M.F.G.B. and New Wages Bill.

The general secretary of the South Wales Miners' Federation last week gave the executive of that body a clear indication of the policy of the M.F.G.B., as well as that of South Wales, on the wages question. He stated that the Executive Committee of the National Miners' Federation had agreed upon the terms of the Minimum Wage Bill, to be introduced to Parliament on May 3rd by Mr. D. R. Grenfell. The Bill was in accordance with the resolution passed at the Annual Conference of the Federation at Folkestone. It laid down the principle that a minimum wage be paid to each grade of workman employed at the collieries, both on the surface and underground, and that the rates of wages should be not less than those paid in 1914, plus the increase in the cost of living, as ascertained by the Ministry of Labour. The Bill would also apply to men engaged in the production of any kind of mineral, apart from coal. A further provision laid down that penalities would be inflicted on employers who neglected to pay the minimum wage to any workman, unless the latter had been specifically exempted by a certificate issued by the District Board.

The Tin-plate Industry.

In the ordinary way of things, the pooling scheme in operation in the tin-plate industry in order to adjust production to demand, would come to an end in September of this year, but it is now understood that as it has proved so successful, it is practically certain that the scheme will be continued to September, 1934, or even later. This fact was disclosed after a meeting of members of the Welsh Plate and Sheet Manufacturers' Association had met and discussed the matter at Swansea last week. As evidence of the improvement in trade, arrangements were made for a resumption this week of work at the Morfa Works of J. S. Tregoning and Sons. This establishment comprises five mills and normally provides employment for 250 men. It had been closed down since July last. The proposal was to start three mills on Monday, and with the object of sharing the work among the operatives, six-hour shifts will be worked.

Contracts for Local Works.

It was announced by the Swansea Main Drainage Committee last week that the contractors engaged on the main trunk sewer contracts had placed orders for cast iron piping with Baldwins, Ltd., at their Landore Works. This, it was said, might mean a new industry for Swansea. The contract given to Messrs. Braithwaite for 2000 tons of steel for the Swansea super electricity generating station means that the steel will be produced at Baldwins' works at Margam or Port Talbot.

Current Business.

Operations from day to day remain quiet, and the demand for coals is more than ordinarily restricted by the exceedingly mild weather prevailing, which affects not only the demand from abroad, but the home trade as well. Large coals are without perceptible improvement, but sized products are well sold ahead, and continue at a premium. Patent fuel is steady without being active, while pitwood if anything,, is a shade steadier. Coke moves off fairly freely.

BRITISH STANDARDS INSTITUTION.

All British Standard Specifications can be obtained from the Publications Department of the Institution at 28, Victoria-street, London, S.W.1. The price of each specification is 2s. 2d. post free, unless otherwise stated.

BUS-BARS AND BUS-BAR CONNECTIONS.

No. 159—1932. This is a revised edition of Specification No. 159, and is applicable to bus-bars surrounded by air, oil, solid or semi-solid insulating materials, whereas the original specification dealt only with bus-bars in air. It deals fully with clearances to earth and between phases, and is the first of a series of revised specifications incorporating new temperature limitations. To enable more efficient use of the metal to be made the standard ambient temperature has been reduced and the permissible temperture rise correspondingly increased, subject to certain limitations on the maximum temperature under certain conditions.

CEILING-TYPE ELECTRIC FANS.

No. 367—1932. This is a revision of an existing specification for the performance of ceiling-type electric fans. The scope of the orignal edition (issued in 1929) was limited to fans having a blade-sweep between 48in. and 60in., but the revised specification is applicable to fans having a blade-sweep as small as 24in. The original method of testing the fans has been slightly modified so as to enable the same test to be used for all fans within the range of 24in. to 60in. blade-sweep.

TRACTIVE ARMATURE D.C. NEUTRAL LINE RELAYS.

No. 475—1932. This is a specification for tractive armature D.C. neutral line relays for signalling purposes, and follows a corresponding specification for track relays issued some months ago. The two specifications are very similar in general form, but naturally differ as regards the limitations relating to the operating characteristics. The figures and tests specified have been agreed upon, after many tests on relays under service conditions, with the express object of facilitating the performance of acceptance tests and the subsequent adjustment, if necessary, in service. The specification for line relays has been approved as being suitable for the requirements of the New Zealand railways, and it is hoped that other parts of the British Empire will also be able to adopt the British Standard Specification, even in those cases where American practice has been largely followed in the past.

EDUCATIONAL INTELLIGENCE.

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY, LONDON, S.W.7.—Arrangements have been made by the governing body for the delivery during session 1932–33 of a series of special lectures on various of the productive industries by lecturers whose experience will enable them to speak with authority. The lectures, which will be given in the Mathematics Lecture Theatre in the Huxley Building of the Royal College of Science, Exhibition-road, S.W.7, are open to all members of the College, staff and students. The lectures during the spring term will be :—(1) By Dr. Kenneth Lee, on the Textile Industries, Thursday, January 26th, 1933, at 4 p.m.; (2) By Sir William Larke, K.B.E., on the Steel Industry, Thursday, February 16th, 1933, at 4 p.m.; (3) on the Heavy Engineering Manufacturing Industries, Thursday, March 9th, 1933, at 4 p.m. (lecturer to be announced later). The lectures given during the autumn term included (*a*) the Chemical Manufacturing Industry, (*b*) the Advantages of the Small Industrial Organisation, (*c*) the Electrical Industry, with special reference to the advantages of the Large Industrial Organisation, and (*d*) the Building Industry. A volume of the seven lectures will subsequently be published.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

THE STEEL BARREL COMPANY (OF UXBRIDGE), Ltd. has opened an office in the Midland Bank Chambers, 77, King-street, Manchester, under the charge of Mr. J. S. Dunn, the firm's northern representative.

GREENWOOD AND BATLEY, Ltd., Albion Works, Leeds, inform us that they have purchased recently the goodwill, patterns, and drawings of John Hands and Sons, Ltd., and Hollings and Guest, Ltd., of Birmingham.

MR. HAROLD S. ASPINALL has resigned his position as the London director of Petters Ltd. and joined the English Electric Company, Ltd., as manager of Diesel engine sales. For the time being Mr. Aspinall's headquarters will be at the London office of the English Electric Company, Queen's House, Kingsway, W.C.2.

HOLDEN AND BROOKE, Ltd., Manchester, inform us that from January 16th their Midland sales area has been placed in the hands of Mr. A. W. A. Joscelyne, who has hitherto been in charge of the sales estimating department at the head office in Manchester. The company's office in Corporation-street, Birmingham, is closing down and Mr. Joscelyne will work from his private address, "Kilcreggan," Walsall-road, Little Aston (Staffs.), near Sutton Coldfield.

CONTRACTS.

THE SUNBEAM MOTOR CAR COMPANY, Ltd., of Moorfield Works, Wolverhampton, has just received an order from the Walsall Corporation for fifteen trolley omnibus chassis.

CALENDARS, DIARIES, &c.

BRITISH JEFFREY-DIAMOND, Ltd., Wakefield.—Wall calendar.

MACHINERY AND TECHNICAL TRANSPORT, Ltd., Ling House, South-street, Finsbury-pavement, E.C.2.—Wall calendar.

PECKETT AND SONS, Ltd., Bristol.—Wall calendar.

SUBMARINE SIGNAL COMPANY (LONDON), Ltd., 9, Victoria-street, S.W.1.—Wall calendar.

VITTY AND SEABORNE, Ltd., 132–5, Long Acre, W.C.1.—Wall calendar.

ED. WOOD AND CO., Ltd., Ocean Ironworks, Manchester.—Wall calendar.

LAUNCHES AND TRIAL TRIPS.

LIGHTERS ; built by Richard Dunston, Ltd., Thorne, Yorkshire, to the order of Joseph Rank, Ltd.; to carry grain. Three lighters were launched and their carrying capacity is about 250 tons of grain each ; launch, Thursday, December 29th.

FINSBURY TECHNICAL COLLEGE OLD STUDENTS' ASSOCIATION.—The Finsbury Old Students' dinner will take place at the Trocadero on March 18th next.

THE DREDGER "FOREMOST SCOT."—We are informed by Alexander Hall and Co., Ltd., of Aberdeen, that the propelling machinery for this vessel was built in the firm's shops, and was not supplied, as stated in our issue of January 6th, by the North-Eastern Marine Engineering Company, Ltd. The Wallsend firm did, however, build 1000 I.H.P. engines for the tug "Foremost" belonging to the same owners, the James Dredging, Towage and Transport Company, Ltd., of Southampton.

THE ROYAL INSTITUTION.—The course of Public Afternoon Lectures at the Royal Institution before Easter will be opened by Professor J. C. M'Lennan, who was until recently Professor of Physics in the University of Toronto, and is now living in this country. He will give an experimental course on the work on "Low Temperatures and Low-temperature Phenomena," with which he and the University of Toronto have been specially identified. Later Sir William Bragg will review the progress in the past twenty years of the science of crystal analysis by X-rays ; and Lord Rutherford will give a Saturday course on the "Detection and Production of Swift Particles." The course will be experimental, and as a part of his subject Lord Rutherford will describe the recent progress at the Cavendish Laboratory by Chadwick, Cockroft, and Walton and others. Sir James Jeans will also give a course — on "Modern Astronomy."

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
(1) Native	15/- to 20/-
(1) Spanish	17/- to 24/-
N.E. COAST—	
Native	18/- to 21/-
Foreign (c.i.f.)	15/3

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	3 6 0	—
No. 1 Foundry	3 10 0	—
No. 3 Foundry	3 7 6	—
N.E. COAST—		
Hematite Mixed Nos.	2 19 0	2 19 0
No. 1	2 19 6	2 19 6
Cleveland—		
No. 1	3 1 0	3 1 0
Siliceous Iron	3 1 0	3 1 0
No. 3 G.M.B.	2 18 6	2 18 6
No. 4 Foundry	2 17 6	2 17 6
No. 4 Forge	2 17 0	2 17 0
Mottled	2 16 6	2 16 6
White	2 16 6	2 16 6
MIDLANDS—		
(c) Staffs.—	(*Delivered to Station.*)	
All-mine (Cold-blast)	—	—
North Staffs. Forge	3 1 0	—
„ „ Foundry	3 6 0	—
(c) Northampton—		
Foundry No. 3	3 2 6	—
Forge	2 17 6	—
(c) Derbyshire—		
No. 3 Foundry	3 6 0	—
Forge	3 1 0	—
(3) Lincolnshire—		
No. 3 Foundry	—	—
No. 4 Forge	—	—
Basic	—	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	3 15 6 (*a*) / 4 0 6 (*b*) / 4 5 6 (*c*)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	9 15 0	9 5 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 5 0	—
Common Bars	9 5 0	—
Best Bars	10 5 0	—
Double Best Bars	10 15 0	—
Treble Best Bars	11 5 0	—
LANCS.—		
Crown Bars	9 15 0	—
Best Bars	10 5 0	—
Hoops	12 0 0	—
S. YORKS.—		
Crown Bars	9 15 0	—
Best Bars	10 15 0	—
Hoops	12 0 0	—
MIDLANDS—		
Crown Bars	9 0 0 to 9 15 0	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	8 0 0 to 8 10 0	—
Gas Tube Strip	10 7 6 to 10 10 0	—

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates (Marine)	9 0 0	8 10 0
„ „ (Land)	—	—
Ship Plates, ¾in. and up	8 15 0	7 15 0
Sections	8 7 6	7 7 6
Steel Sheets, ¼in.	7 15 0	7 15 0
Sheets (Gal. Cor. 24 B.G.)	11 5 0–10 Ton	10 0 0
	Lots and Upwards Delivered Glasgow Stations.	
„ (Gal. Cor. 24 B.G.)	For Canada	10 15 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 15 0	7 15 0
Angles	8 7 6	7 7 6
Boiler Plates (Marine)	10 10 0	—
„ „ (Land)	10 0 0	—
Joists	8 15 0	7 7 6
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	7 2 6	—
Soft Billets	5 10 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	—
Billets	6 10 0 to 9 0 0	—
MANCHESTER—		
Bars (Round)	9 7 6	—
„ (Small Round)	6 15 0	—
Hoops (Baling)	10 0 0	9 15 0
„ (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
„ (Lancs. Boiler)	8 10 0	—
SHEFFIELD—		
Siemens Acid Billets	9 2 6 (basis)	—
Hard Basic	8 2 6 and 8 12 6	—
Intermediate Basic	6 12 6 and 7 2 6	—
Soft Basic	5 15 0	—
Hoops	9 10 0 to 9 15 0	—
Soft Wire Rods	7 10 0	—
MIDLANDS—		
Small Rolled Bars (all British)	7 0 0 to 7 5 0	—
Small Re-rolled Bars	6 15 0 to 6 17 6	—
Billets and Sheet Bars	4 17 6 to 5 7 6	—
Galv. Sheets	11 15 0 to 13 15 0	10 10 0
(2) Staffordshire Hoops	9 10 0	—
(*d*) Angles	8 7 6	—
(*d*) Joists	8 15 0	—
(*d*) Tees	9 7 6	—
(*d*) Bridge and Tank Plates	8 17 6	—
Boiler Plates	8 5 0 to 8 7 6	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14 f.o.b.	15/9 to 16/3
Block Tin (cash)	145 5 0
„ (three months)	145 15 0
Copper (cash)	28 5 0
„ (three months)	28 11 3
Spanish Lead (cash)	10 11 3
„ „ (three months)	10 18 9
Spelter (cash)	14 10 0
„ (three months)	14 15 0
MANCHESTER—	
Copper, Best Selected Ingots	32 15 0
„ Electrolytic	33 15 0
„ Strong Sheets	65 0 0
„ Tubes (Basis Price), lb.	0 0 10
Brass Tubes (Basis Price), lb.	0 0 9
„ Condenser, lb.	0 0 11½
Lead, English	12 10 0
„ Foreign	11 2 6
Spelter	14 17 6
Aluminium (per ton—raw ingot)	£95

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/10½ per lb.	
Ferro Tungsten	1/7½ per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£25 15 0	8/-
„ „ 6 p.c. to 8 p.c.	£24 10 0	7/6
„ „ 8 p.c. to 10 p.c.	£22 5 0	7/-
„ „ Specially Refined		
„ „ Max. 2 p.c. carbon	£36 10 0	11/-
„ „ „ 1 p.c. carbon	£42 12 0	14/-
„ „ „ 0·70 p.c. carbon	£44 0 0	16/-
„ „ „ carbon free	1/- per lb.	
Metallic Chromium	2/9 per lb.	
Ferro Manganese (per ton)	£10 15 0 for home	
„ „ „	£9 15 0 for export	
„ Silicon, 45 p.c. to 50 p.c.	£13 10 0 scale 5/- per unit	
„ „ 75 p.c.	£19 10 0 scale 6/- per unit	
„ Vanadium	12/6 per lb.	
„ Molybdenum	6/3 per lb.	
„ Titanium (carbon free)	9d. per lb.	
Nickel (per ton)	£245 0 0	
Ferro Cobalt	7/9 per lb.	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	15/6
„ „ Ell	16/- to 16/6
„ „ Splint	16/- to 17/6
„ „ Trebles	15/-
„ „ Doubles	12/6
„ „ Singles	11/-
AYRSHIRE—	
(f.o.b. Ports)—Steam	14/6
„ „ Jewel	16/6
„ „ Trebles	15/6
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	13/- to 15/-
Screened Navigation	16/6 to 17/6
Trebles	15/6 to 18/6
Doubles	12/6 to 14/-
Singles	10/9 to 11/-
LOTHIANS—	
(f.o.b. Leith)—Best Steam	13/6 to 14/-
Secondary Steam	13/6
Trebles	15/6
Doubles	12/- to 12/6
Singles	11/- to 11/3

(8) N.W. COAST— ENGLAND.

Steams	19/- to 23/6
Household	32/6 to 52/6
Coke	18/- to 21/-
NORTHUMBERLAND—	
Best Steams	14/6
Second Steams	12/6 to 12/9
Steam Smalls	8/6
Unscreened	12/6 to 13/-
Household	27/- to 39/-
DURHAM—	
Best Gas	14/6
Second	13/3 to 13/6
Household	25/- to 37/-
Foundry Coke	24/-

SHEFFIELD	Inland.
Best Hand-picked Branch	27/- to 28/-
South Yorkshire Best	23/- to 24/-
South Yorkshire Seconds	18/- to 21/-
Derbyshire Best House	22/- to 23/6
Derbyshire Best Brights	18/- to 20/-
Screened Seconds	17/6 to 19/-
Kitchen Coal	16/6 to 17/6
Best Screened Nuts	17/- to 18/6
Small Screened Nuts	16/- to 16/6
Yorkshire Hards	17/- to 18/-
Derbyshire Hards	17/- to 18/-
Rough Slacks	8/6 to 9/6
Nutty Slacks	7/- to 8/6

Blast-furnace Coke (Inland) 10/- on rail at ovens

Furnace and Foundry Coke (Export), f.o.b., 14/6 to 15/6

(9) SOUTH WALES.

CARDIFF—	
Steam Coals :	
Best Smokeless Large	19/6 to 19/9
Second Smokeless Large	18/9 to 19/6
Best Dry Large	19/- to 19/6
Ordinary Dry Large	17/9 to 18/3
Best Black Vein Large	18/3 to 18/6
Western Valley Large	17/9 to 18/-
Best Eastern Valley Large	17/7½ to 17/9
Ordinary Eastern Valley Large	17/3 to 17/6
Best Steam Smalls	13/- to 13/6
Ordinary Smalls	11/- to 13/-
Washed Nuts	20/- to 32/-
No. 3 Rhondda Large	19/6 to 19/9
„ „ Smalls	15/- to 16/-
No. 2 „ Large	17/- to 17/3
„ „ Through	15/6 to 16/-
„ „ Smalls	14/- to 14/3
Foundry Coke (Export)	22/6 to 36/6
Furnace Coke (Export)	17/- to 18/-
Patent Fuel	22/-
Pitwood (ex ship)	21/- to 21/6
SWANSEA—	
Anthracite Coals :	
Best Big Vein Large	36/- to 38/6
Seconds	27/- to 34/-
Red Vein	22/- to 26/6
Machine-made Cobbles	37/6 to 48/6
Nuts	36/6 to 48/6
Beans	28/6 to 32/6
Peas	19/6 to 21/-
Breaker Duff	8/6 to 9/6
Rubbly Culm	8/6 to 9/-
Steam Coals :	
Large	20/- to 20/6
Seconds	18/- to 20/-
Smalls	11/6 to 13/-
Cargo Through	16/- to 17/6

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate : Joists (minimum), 22/6; Ordinary Ship, Bridge, and Tank Plates and Sections, 15/-, if home consumers confine purchases from associated British Steel Makers. (*e*) Delivered Black Country Stations.

French Engineering Notes.

(From our own Correspondent in Paris.)

The "Atlantique."

THE destruction of the "Atlantique" has left the Compagnie Sud-Atlantique with two modern ships, the "Lutetia" and "Massilia," which will continue the service to South America, and there is now a question of building a replica of the lost liner in order that the French mercantile marine may regain its prestige in the Southern Atlantic. The liner was almost necessarily run at a loss, but the French believe that such loss is more than covered by indirect benefits accruing from the popularity of big and fast ships, while luxurious equipment was regarded as an equally important factor in drawing traffic, until its dangers were made manifest by recent catastrophes. In French opinion, such ships give a reputation to the French marine which is not without political value, and their popularity helps trade and tends to bring additional freight to the fleet generally. The "super" ship which makes the world marvel is a considerable national asset, even though it be costly to run. That was the policy which the French Government inaugurated at the time it required the subsidised shipping companies to build ultra-modern liners. When it was decided to construct the "Atlantique" a new convention was entered into with the Compagnie Sud-Atlantique whereby the Treasury would guarantee the money raised for its construction. It was intended that the first ship should be followed by a similar one when the economical conditions were more favourable, but as they have become far more difficult it is by no means certain that another "Atlantique" will be put in hand so soon as the Government is urged to do. A careful consideration of equipment will have to be made when the inquiries into the loss of the liner are completed, and it is understood that work on the "Normandie" will be suspended in consequence, notwithstanding that an awkward situation has been created by the fact that all orders for the decorative equipment have been distributed.

Ship Fire Protection.

At a meeting of representatives of shipping companies at the Ministry of the Merchant Marine last week a series of recommendations was drawn up with a view to preventing as far as possible any recurrence of the disasters by fire which have overtaken shipping, and the Minister, Monsieur Meyer, presented them to the Commission of the Merchant Marine, which has been fully occupied in dealing with questions affecting the loss of the "Georges Philippar" and the "Atlantique." In June, 1931, the Chamber of Deputies passed a Bill providing for greater security to shipping, and the Senate is to be asked to approve of it so that the new law can come into operation with as little delay as possible. The recommendations adopted at the meeting last week are to the effect that a ship carrying more than 250 persons must have on board from three to six seamen who have received training either in a fire brigade or in a similar corps during their military service, and that ships of more than 15,000 tons are required to have three professional firemen, whose sole duty it will be to guard the vessel against fire. In ships under construction the use of wood will be prohibited for staircases, lifts, gangways, and wireless cabins; veneered wood employed elsewhere must be coated with asbestos, and there are other regulations concerning the insulation of wood wherever its use is authorised. Strict regulations are also proposed as regards the fire-resisting character of hangings and rubber carpets, and the commission on paints and varnishes is required to provide specifications of such materials as can be used with safety. The navigating bridge and the wireless cabin must be entirely metallic and completely isolated and ventilated so that they may continue to be occupied in case of fire. In ships of more than 10,000 tons there will be two wireless cabins, one fore and the other aft. The inquiry into the loss of the "Atlantique," so far as it has gone, shows the probability of the fire having broken out in two distinct places, and statements of witnesses to the effect that it originated in two cabins separated by fireproof partitions, at an interval of about an hour and a-half, appear to be confirmed by electric clocks which stopped at the times stated, the clocks being in different circuits. The possibility of the steel sheathing of an insufficiently insulated cable being alive through electric leakage at a voltage below that provided for by the fuses, and high enough to break down poor insulation between the sheathing and the cable to form arcs at different points along the line, is regarded as an explanation of simultaneous fires. It is therefore recommended that all sheathed cables shall be fixed to iron beams and stringers, and that where they are unavoidably carried on wood the sheathing must have metallic leads to the hull. There are other recommendations which are mostly repetitions of regulations observed in all mercantile marines.

The Steel Trade.

The demand for bars and sheets from China and Japan is attributed to the hostile attitude of those countries towards each other, and a continuance of buying is therefore dependent upon how the situation will develop. The effect has been to harden international prices for those materials. There is otherwise no change in the steel trade, and the only hope of improvement lies in the successful carrying out of negotiations for the reconstitution of the steel cartel. The meeting in Brussels last week of representatives of the countries that adhered to the old cartel discussed the conditions under which an international comptoir should be created for the sale of semi-steels, and it is declared that some progress was made, though it is rumoured that the German delegates were rather more exacting than at the previous meeting in Paris. Another meeting is to be held towards the end of the month, probably at Brussels. The creation of the sales comptoir is an indispensable preliminary to the reconstitution of the cartel, upon which all hopes are now based of an improvement in the steel trade. It will mean a stabilising of international prices at something like a remunerative level and possibly more active buying by consumers in anticipation of an advance. There is nothing, however, to indicate a sustained revival of buying at a time when, as in this country, all attempts to create work are suspended by financial difficulties.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

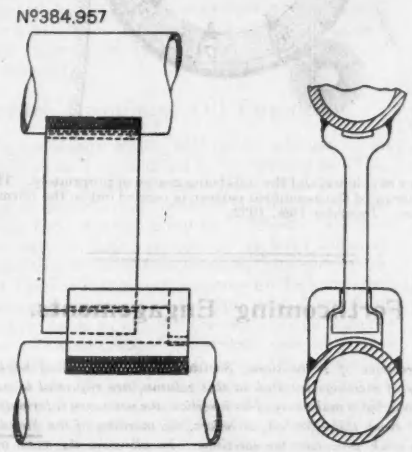
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM GENERATORS.

384,957. August 15th, 1932.—SUPPORTS FOR SUPERHEATER PIPES, *The Superheater Company, Ltd., Bush House, Aldwych, London, W.C.2.*

It is pointed out that superheater supports may become abnormally hot on account of their lack of intimate contact with the pipes and the consequent check to the heat being

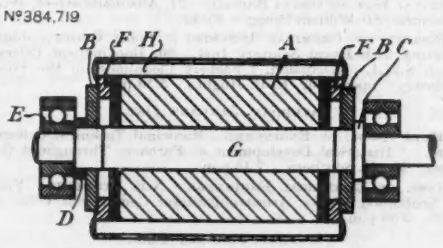


conducted away. The inventors consequently use the style of hanger shown, which is welded to the pipe to ensure good heat conductivity. A sliding joint is provided between the two parts of the hanger to allow for the relative movement of the two pipes.—*December 15th*, 1932.

DYNAMOS AND MOTORS.

384,719. September 9th, 1931.—SQUIRREL CAGE ROTORS FOR INDUCTION MOTORS SUBJECTED TO AXIAL VIBRATION, Siemens-Schuckertwerke Aktiengesellschaft, of Berlin-Siemensstadt, Germany.

Despite the use of resilient intermediate members, the vibrations and oscillations occurring during the operation of percussion tools driven by electric motors are transmitted to the rotor of the motor. The masses of the rotor short-circuiting rings exert a considerable tensile force on the rotor bars, and since they usually consist of copper they are stretched, and the laminations are loosened. The object of the invention is to overcome this trouble. The laminated rotor core A is held

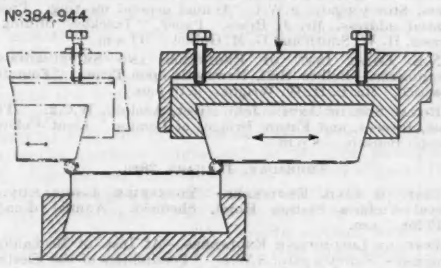


together by strong discs B. At one end of the rotor the pressure disc B bears against a shaft collar C, and at the other end against a distance sleeve D, which, in turn, bears against the inner race of the ball bearing E. In order to be able to preserve the axial length of the laminated rotor core accurately, the short-circuiting rings F are machined to receive the bearing surfaces of the pressure discs B. In this way the laminated rotor core, together with the short-circuiting rings, is rigidly connected to the shaft G, so that the occurrence of oscillations of the short-circuiting rings and hence the stretching of the rotor bars H is impossible. By means of the distance sleeve D the pressure disc B may also be pressed by a screw or in any other suitable manner against the short-circuiting ring F.—*December 15th*, 1932.

MACHINE TOOLS AND SHOP APPLIANCES.

384,944. July 25th, 1932.—SCREW THREAD ROLLING DIES, H. Fuld, 71, Frauentorgraben, and E. Hessdörfer, 10, Tiergartenstrasse, Nuremburg, Germany.

"A method for the production of screw thread rolling dies with only grooves and ribs extending parallel to one another

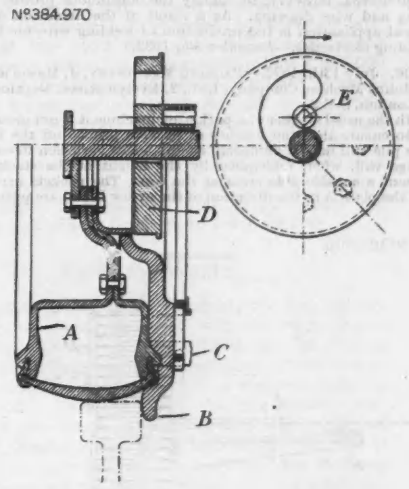


and not intersecting, characterised in that the grooves and ribs are rolled into the blanks by rolling a tool screw bolt between the plane faces of the blank." The illustration is self-explanatory. A co-pending specification, No. 384,949, describes the tools for making the threads.—*December 15th*, 1932.

TRAMWAYS AND RAILWAYS.

384,970. October 12th, 1932.—COMBINED WHEELS FOR ROAD AND RAIL, V. H. Nalinne, 2, Avenue Géo Bernier, Brussels, Belgium.

The wheel A has a pneumatic tire for running on the road

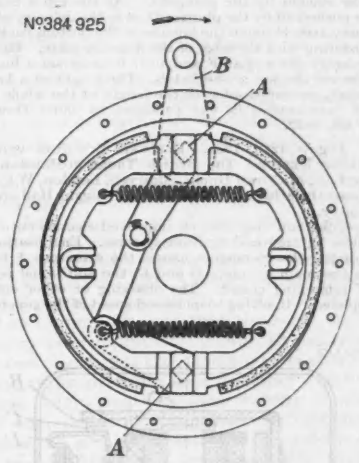


and a flange B for running on rails, which is attached by studs C. When it is desired to run on the road, the flange is released from the studs and slid on to the drum D. This drum is fixed on the peg E, and by giving this peg a half revolution round the axle the flange is lifted off the ground.—*December 15th*, 1932.

MOTOR CARS AND ROAD TRAFFIC.

384,925. June 27th, 1932.—BRAKES, Condor Manufacture Suisse de Cycles et Motorcycles, Courfaivre, Switzerland.

The shoes of this brake have a smaller radius of curvature than the drum. They are expanded by the cams A A, which



are linked together and operated by the lever B. When applied the brakes first touch the drum at the centre, and are then bent outwards until they touch throughout their length. The brake is said to be very flexible and sensitive.—*December 15th*, 1932.

MISCELLANEOUS.

384,585. June 20th, 1932.—WIRE MANUFACTURE, *The British Thomson-Houston Company, Ltd., Crown House, Aldwych, London, W.C.2.*

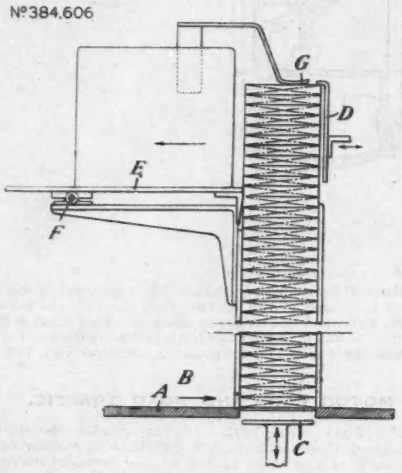
This invention relates to wire making processes and is concerned with a method of speeding up the process relation to the preparation of ferrous rods for the wire drawing operation. One of the important steps in connection with the making of wire is the proper preparation of the rods for the wire drawing operation. The rods must first be freed from scale or oxide, else the die through which the wire is drawn will be ruined. The general practice is to remove the scale on the rods with dilute sulphuric or hydrochloric acid. After so cleaning the rods they are well washed and allowed to stand until they are rusted (as termed by wire drawers, "browned") or in chemical terms they are coated with a film of ferric hydroxide. After the rod has rusted it is dipped into boiling lime water, drained and dried in ovens at about 100 deg. Cent. The thin coating of lime on top of the ferric hydrate serves the purpose of protecting the brown coat and also of keeping the rod from corroding and in addition acts as a dry lubricant in the subsequent wire drawing operations. The rod is then subjected to drawing operations, first through chilled iron dies and finally through steel and diamond dies. The inventors have, they say, discovered a method whereby they can materially speed up the process of putting on the rust coat and lime on the rods prior to the drawing operations, and hence materially speed up the entire process of wire making. The process comprises briefly the making of the rod the anode for a few seconds in a bath of lime and water while passing electric current therethrough, after which the rod is dried in air for a short period of time. Iron rod is rolled down to a suitable diameter, say, ¼in., and coiled, if desired. It is then made the anode in a bath of lime and water. Ordinarily a so-called solution of milk of lime is used as the bath. This is a saturated solution of calcium hydroxide carrying the excess of lime in suspension. Preferably an elevated temperature is employed, such as 90 deg. to 100 deg. Cent. The time of treatment is very short, usually five to fifteen seconds. A current density of 1 ampère per running inch of the rod is satisfactory. A separate cathode of any suitable material may be employed or the walls of the tank may be used as the cathode. A gelatinous coating of ferrous hydrate is formed on the surface of the rod and this occludes and carries out of the bath with it an appreciable quantity of both free lime and its solution in water. On drying in air the green ferrous hydrate next to the rod rapidly oxidises to brown ferric hydrate and probably dehydrates partially to ferric oxide. The lime dries out also with the ferric hydrate. The rod is preferably fed continuously

through the bath and at a rate such that it acquires the proper coating and is dried in air after leaving the bath. Either air at room temperature or warmed air may be used. The coated rod is, after leaving the bath and being dried, fed through the usual wire drawing dies. The operation is thus continuous. The separate coils of metallic rod may be made the anodes as such in the bath instead of being fed through the bath as outlined. It is preferred, however, to employ the continuous process of coating and wire drawing. As a result of the invention one practical application is the production of welding wire for use in welding electrodes.—*December 8th*, 1932.

384,606. July 13th, 1932.—PACKING MACHINERY, J. Mason and Molins Machine Company, Ltd., 2, Evelyn-street, Deptford, London, S.E.8.

With the usual stacker of a packeting machine it is not always easy to ensure that the batches of packets pushed off the top of the pile will not be damaged, as any small variation in each package will, when multiplied by the height of the stacker, represent a considerable error at the top. The packets arrive along the plate A in the direction of the arrow B and are pushed

Nº384,606

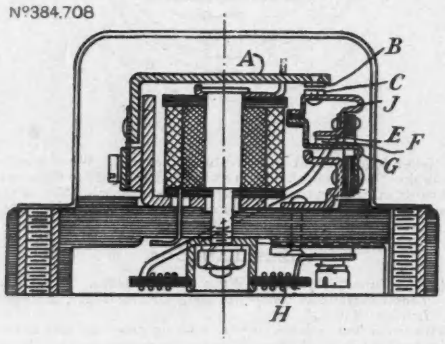


up into the stacker by the plunger C. At the top a batch of, say, ten is pushed off by the plunger D on to the delivery plate E. Trouble may arise through the bottom of the bottom packet not quite registering with the edge of the delivery plate. The plate is consequently pivoted at F and to it is attached a finger G, which rests on the top of the batch. The height of a batch is not sufficient, as compared with the height of the whole stack, for slight inaccuracies in the packages to cause trouble.—*December 8th*, 1932.

384,708. August 12th, 1931.—ELECTRIC CUT-OUTS AND CONTROLLING DEVICES, The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C.2, and Leonard Griffiths, of "Kennington," Biggin Hall-crescent, Coventry.

This specification describes an improved electric cut-out for road vehicle lighting and ignition systems. Energisation of a winding of the electro-magnet causes the armature A to drop and close the main contacts B and C, the additional contacts E and F remaining closed. The charging or other circuit is thus completed. If, owing to increased speed of the generator or

Nº384,708

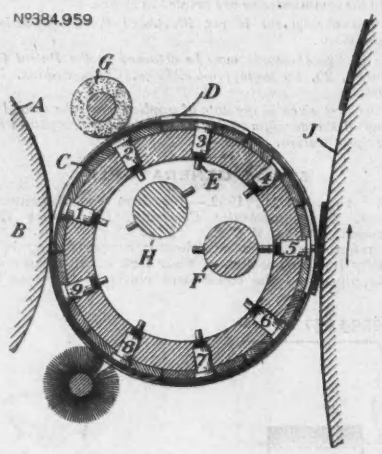


to other cause, such as low load, the voltage or current becomes excessive, the armature drops further to depress the second phosphor bronze strip G, and thus separates the additional contacts E and F. Resistance H is thus inserted in the battery circuit or in the field circuit of a wound field generator. The resiliency of the arm-carrying the contact J permits the further movement after the contacts B and C have closed. The main contacts B and C remain closed until the minimum limit of current or voltage is reached, but the additional contacts reclose when the current or voltage returns to an intermediate value.—*December 15th*, 1932.

384,959. August 16th, 1932.—LINOLEUM MACHINERY, The Armstrong Cork Company, Lancaster, Pennsylvania.

This invention concerns the manufacture of linoleum inlaid with rectangular patterns. The usual process is to cut into rectangles several sheets of the desired colours, to select from each sheet the pieces necessary to make up the pattern, apply them to the backing material, and reject the remainder. The result is that with two colours alternating as much material is scrapped as is used. By the inventor's process all the material is used. The illustration shows one of the two rolls necessary for working on a two-colour pattern. A sheet A of linoleum of half the thickness of the desired product is fed over the platen roll B, and is cut up into squares by the knives C. Between each pair of knives there is a stripper plate D attached to a pin E. These pins are operated by corresponding pins on the internal roll F, which is so geared that each alternate stripper plate is pushed out after two revolutions of the knife drum. The result is as follows:—Taking the station 1, for instance, the knives cut a square from the sheet A and it lies on the stripper plate of that station. When station 2 arrives opposite the roll B it brings with it an already cut square, on the top of which a second layer is applied. The stripper plate of station 3 is empty, and when it arrives opposite the roll G it is pushed out by the roll H to receive a film of oil to prevent the adhesion of the linoleum. It then goes on to be treated like station 1. It will thus be seen that the stations 5, 7, 9 are each charged with a double thickness, while 2, 4, 6, 8 have single thicknesses. At station 5 the stripper plate is pushed out to apply the two layers to the backing hessian J; but when station 6 arrives it will be missed by the ejecting roll and will go on to receive its second layer. The same process is, of course, carried out by a second unit in applying the other colour in the intermediate spaces. The system can be applied to any number of colours, within reason, the number of thicknesses corresponding to the

Nº384,959



number of colours, and the rolls being geared appropriately. The calendering of the assembled pattern is carried out in the normal manner.—*December 15th*, 1932.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Monday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

INST. OF AUTOMOBILE ENGINEERS: WESTERN CENTRE.—Grand Hotel, Bristol. Dinner. 7.30 p.m.

INST. OF CIVIL ENGINEERS: YORKSHIRE.—Grand Hotel, Sheffield. Institution lecture to students, "Impact in Railway Bridges—Retrospect and Present-day Aspect," Mr. Conrad Gribble. 7.30 p.m.

INST. OF FUEL.—University College, Nottingham. "Recent Fuel Developments," Prof. McMillan and Mr. A. Dawe. 7.30 p.m.

INST. OF MECHANICAL ENGINEERS.—Storey's-gate, S.W.1. Informal meeting. Discussion, "Can Engineers Reduce Unemployment?" Mr. T. S. Catmur. 7 p.m.

JUNIOR INST. OF ENGINEERS.—39, Victoria-street, S.W.1. "Notes on Welded Steel Work at Freemasons' Hospital," Mr. S. Bylander. 7.30 p.m.

PHYSICAL SOCIETY.—Imperial College of Science and Technology, South Kensington, S.W.7. Meeting. 5 p.m.

ROYAL INST. OF GREAT BRITAIN.—21, Albemarle-street, W.1. Discourse, Sir William Bragg. 9 p.m.

SOCIETY OF CHEMICAL INDUSTRY: FOOD GROUP.—Joint meeting with Royal Sanitary Inst. 90, Buckingham Palace-road, S.W.1. Discussion, "Factory Cleanliness in the Food Industry," opener Mr. E. B. Hughes. 5.30 p.m.

SATURDAY, JANUARY 21ST.

HULL ASSOC. OF ENGINEERS.—Municipal Technical College, Hull. "Historical Development of Furnaces Throughout the Ages," Mr. H. Southern. 7.15 p.m.

INST. OF ELECTRICAL ENGINEERS: N.E. STUDENTS.—Visit to Scotswood Works, Armstrong-Saurer Commercial Vehicles, Ltd. 3.30 p.m.

MONDAY, JANUARY 23RD.

BRADFORD EDUCATION COMMITTEE.—Technical College, Bradford. "Metallurgical Aspects of Electric Welding," Mr. J. H. Patterson. 7.30 p.m.

INST. OF MECHANICAL ENGINEERS: GRADUATES—Storey's-gate, S.W.1. "Steam-raising Plant and the Modern Central Power Station," Mr. C. H. Russell. 6.45 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, W.C.2, Howard Lectures, "Thermal Insulation," Dr. Ezer Griffiths. F.R.S. 8 p.m.

TUESDAY, JANUARY 24TH.

SHEFFIELD METALLURGICAL ASSOCIATION.—198, West-street, Sheffield. Symposiums on "Hardness Testing Machines." 7.30 p.m.

WEDNESDAY, JANUARY 25TH.

INST. OF CHEMICAL ENGINEERS.—At Chemical Society, Burlington House, W.1. "Sewage Disposal." "British Practice in Sewage Disposal," Mr. H. C. Whitehead and Mr. F. R. O'Shaughnessy; "Sewage Treatment in America," Mr. L. R. Howson; "German Practice in Sewage Disposal," Dr.-Ing. Karl Imhoff. 5.30 p.m.

INST. OF MINING ENGINEERS.—At Inst. of Mechanical Engineers, Storey's-gate, S.W.1. Annual general meeting. Presidential address, Mr. J. Brass. Paper, "Trackless Mining." Messrs. H. W. Smith and G. M. Gullick. 11 a.m.

N.E. COAST INST. OF ENGINEERS AND SHIPBUILDERS: GRADUATES.—Bolbec Hall, Newcastle-upon-Tyne. "Foundry Practice," Mr. L. H. W. Wright. 7.15 p.m.

ROYAL SOC. OF ARTS.—John-street, Adelphi, W.C.2. "The Past, Present, and Future Bridges of London," Lieut.-Colonel Joseph Benskin. 8 p.m.

THURSDAY, JANUARY 26TH.

INST. OF CIVIL ENGINEERS: YORKSHIRE ASSOCIATION.—Royal Victoria Station Hotel, Sheffield. Annual dinner. 6.30 for 7 p.m.

INST. OF LOCOMOTIVE ENGINEERS.—At Inst. of Mechanical Engineers, Storey's-gate, S.W.1. "Possibilities of the Electric Furnace in the Foundry," Mr. B. R. Byrne. 6 p.m.

INST. OF STRUCTURAL ENGINEERS.—10, Upper Belgrave-street, S.W.1. "Stone Decay," Mr. E. F. Power. 6.30 p.m.

ROYAL AERONAUTICAL SOC.—At Royal Soc. of Arts, John-street, W.C.2. "Physiological Limitations of Flying," Wing Commander G. S. Marshall. 6.30 p.m.

FRIDAY, JANUARY 27TH.

INSTITUTIONS OF ELECTRICAL, AND MECHANICAL ENGINEERS: GRADUATES AND STUDENTS: AND LONDON STUDENTS OF CIVIL ENGINEERING.—Victoria Halls, Southampton-row, W.C.1. Dance. 7.30 p.m.

INST. OF ELECTRICAL ENGINEERS.—Grand Hotel, Harrogate. Dinner and dance. 8 p.m.–2 a.m.

INST. OF MECHANICAL ENGINEERS.—Storey's-gate, S.W.1.—"Handling and Storing of Grain, with Special Reference to Canadian Methods," Mr. H. H. Broughton. 6 p.m.

JUNIOR INST. OF ENGINEERS.—39, Victoria-street, S.W.1. "Some Experiments on Reinforced Concrete Slabs," Mr. R. H. Squire. 7.30 p.m.

N.-EAST COAST INST. OF ENGINEERS AND SHIPBUILDERS.—Mining Institute, Newcastle-upon-Tyne. "Modern Ship Repairing," Mr. J. Patton. 6 p.m.

ROYAL SOC. OF ARTS.—John-street, Adelphi, W.C.2. "Railway Electrification in India," Mr. F. Lydall. 4.30 p.m.

MONDAY, JANUARY 30TH.

INST. OF PRODUCTION ENGINEERS: YORKSHIRE SECTION.—Hotel Metropole, Leeds. Inaugural meeting. Speakers, Sir Herbert Austin, Messrs. S. Carlton Smith, R. H. Hutchinson, and James G. Young. 7.30 p.m.

ROYAL SOC. OF ARTS.—John-street, Adelphi, W.C.2. Howard Lectures. "Thermal Insulation," Dr. Ezer Griffiths, F.R.S. 8 p.m.

TUESDAY, JANUARY 31ST.

INST. OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND.—39, Elmbank-crescent, Glasgow, C.2. "Propulsive Efficiency and Seaworthiness of a Ship in Smooth and Rough Waters," Mr. J. L. Kent. 7.30 p.m.

INST. OF MARINE ENGINEERS.—The Minories, E.C.3. "Pulverised Coal Firing in Marine Scotch Boilers," Messrs. W. G. Gibbons and M. Arthurson. 6 p.m.

SHEFFIELD METALLURGICAL ASSOCIATION.—190, West-street, Sheffield. "Manufacture of the Mammoth Cunarder Castings," Mr. F. Swift. 7.30 p.m.

WEDNESDAY, FEBRUARY 1ST.

INST. OF CIVIL ENGINEERS: MANCHESTER AND DISTRICT ASSOCIATION.—Midland Hotel, Manchester. Annual dinner. 6.30 for 7 p.m.

THURSDAY, FEBRUARY 2ND.

INST. OF AUTOMOBILE ENGINEERS.—Merchant Venturers' Technical College, Bristol. "Alloy Cast Irons in Automobile Construction," Dr. A. B. Everest. 7 p.m.

INST. OF FUEL.—The University, Bristol. Joint meeting with the Soc. of Chemical Industry. "Elimination of Dust and Sulphur from Flue Gases," Mr. H. E. Wallsom. 7.30 p.m.

INST. OF METALS.—University, Birmingham. "Refractories in Metallurgical Industries," Mr. A. T. Green. 7 p.m.

FRIDAY, FEBRUARY 3RD.

JUNIOR INST. OF ENGINEERS.—39, Victoria-street, S.W.1.—"Dredging for Alluvial Tin," Mr. H. W. Sewell. 7.30 p.m.

SOUTHERN RAILWAY PUPILS' AND PREMIUM APPRENTICES' ASSOCIATION.—Charing Cross Hotel, W.C.2. Annual dinner. Tickets may be obtained from Mr. E. Forge, 159, Desborough-road, Eastleigh.

SATURDAY, FEBRUARY 4TH.

INST. OF BRITISH FOUNDRYMEN: LANCASHIRE.—Grand Hotel, Manchester. Annual Whist Drive, Dinner and Dance. 4 p.m. to Midnight.

STAFFORDSHIRE IRON AND STEEL INST.—Dudley Arms Hotel, Dudley. Annual dinner. 6.30 p.m.

MONDAY, FEBRUARY 6TH.

ENGINEERS' GERMAN CIRCLE.—At Inst. of Mechanical Engineers, Storey's-gate, S.W.1. "A Review of Iron and Steel Manufacture," Herr Victor B. Reichwald. 6 p.m.

ROYAL SOC. OF ARTS.—John-street, Adelphi, W.C.2. Howard Lecture, "Thermal Insulation," Dr. Ezer Griffiths, F.R.S. 8 p.m.

TUESDAY, FEBRUARY 7TH.

BRADFORD EDUCATION COMMITTEE.—Technical College, Bradford. "Design of Welded Structures," Mr. C. Helsby. 7.30 p.m.

DIESEL ENGINE USERS ASSOCIATION.—Coventry Restaurant, Wardour-street, W.1. Annual dinner. 7 for 7.30 p.m.

WEDNESDAY, FEBRUARY 8TH.

INST. OF METALS: LONDON LOCAL SECTION.—Joint meeting with the Food Group of Soc. of Chemical Industry. Burlington House, W.1. Discussion, "Non-ferrous Metals in the Food Industry." 8 p.m.

ROYAL SOC. OF ARTS.—John-street, Adelphi, W.C.2. "Design and Form as Applied to the Manufacture of Glassware," Mr. J. H. Hogan. 8 p.m.

FRIDAY, FEBRUARY 10TH.

INST. OF METALS.—The University, Sheffield. "Soft Solders and Fluxes," Dr. O. F. Hudson. 7.30 p.m.

JUNIOR INST. OF ENGINEERS.—39, Victoria-street, S.W.1. "Oil from Coal," Dr. C. H. Lander. 7.30 p.m.

SHEFFIELD METALLURGICAL ASSOCIATION.—Royal Victoria Hotel, Sheffield. Supper-dance. 7.30 p.m. to 1 a.m.

MONDAY, FEBRUARY 13TH.

INST. OF METALS.—At 39, Elmbank-crescent, Glasgow. "Modern Light Alloys, with Particular Reference to Corrosion," Dr. Leslie Aitchison. 7.30 p.m.

TUESDAY, FEBRUARY 14TH.

INST. OF METALS.—Armstrong College, Newcastle-upon-Tyne. "Refractory Materials and the Non-ferrous Industries," Mr. A. B. Searle. 7.30 p.m.

INST. OF METALS.—Y.M.C.A., Swansea. "Platinum Metals," Mr. R. H. Atkinson. 6.15 p.m.

THURSDAY, FEBRUARY 16TH.

INST. OF ELECTRICAL ENGINEERS.—Grosvenor House, Park-lane, W.1. Annual dinner and reunion. 7 p.m. for 7.30 p.m.

INST. OF STRUCTURAL ENGINEERS.—Hotel Metropole, Leeds. "Some Notes on Floor Construction," Mr. E. S. Andrews. 7 p.m.

MONDAY, FEBRUARY 20TH.

ENGINEERS' GERMAN CIRCLE.—At Inst. of Mechanical Engineers, Storey's-gate, S.W.1. "New Developments in the Design of Rolling Mill Equipment," Herr Dip.-Ingenieur Ernst Kugel. 6 p.m.

FRIDAY, MARCH 17TH.

INST. OF STRUCTURAL ENGINEERS.—May Fair Hotel, W.1. Annual dinner.

MONDAY, APRIL 3RD.

BRADFORD EDUCATION COMMITTEE.—Technical College, Bradford. "Lead Burning and Copper and Iron Welding for Plumbers and Heating Engineers," Mr. E. B. Partington. 7.30 p.m.

A Seven-Day Journal

Duty on Copper.

As recorded in a Journal note of November 4th, 1932, an agreement was reached in October 26th last between Empire copper producers and consumers, with the intention of ensuring a progressive change-over from non-Empire to Empire copper. The agreement provides for the setting up of a Joint Committee, fully representative of the copper and allied trades, which will consult with the copper producers in order to assist them in their endeavours to satisfy consumers' requirements in respect of quality. Such a Committee, called the "Technical Committee," has now been constituted by the Fiscal Policy Joint Committee of the Brass, Copper and Nickel Industries, by continuing the existence of its Technical Sub-committee and by the addition of new members in order to make it representative of the whole trade. The new Committee, which is under the chairmanship of Mr. A. J. G. Smout, of Birmingham, with Mr. J. Lester Smith as its secretary, will meet at intervals, and will consider information and suggestions relating to experience with Empire copper from trade representatives and from those interested in Empire copper and its applications. The Empire copper producers are to be invited to collaborate with the Technical Committee, either direct or through the Joint Committee of producers and consumers, with a view to achieving the end desired, namely, the securing of suitable supplies of Empire copper.

Industrial Italy.

LAST Saturday, January 21st, the Italian Cabinet, in its efforts to improve the position of Italian industries, decided to create a body, to be known as the Institute for Industrial Reconstruction. As at present planned, the Institute, the President of which will be nominated by Royal Decree upon the proposal of the head of the Government, will consist of two sections. One, financed by such institutions as the Cassa de Positi e Prestili, Cassa Nazionalle delle Assicurazione Sociali, and the Instituo Nazionalle delle Assicurazione, and authorised to have a capital of 100 million lira, will grant loans to private enterprises of Italian nationality against suitable guarantees in order that such enterprises may be reorganised. The bonds issued will be redeemable in not less than fifteen and not more than twenty years. The other section, which, it appears, is to supersede the Institute of Liquidations, will receive a subsidy of about 85 million lira a year for twenty years, and will liquidate those concerns which are unlikely to recover from the present industrial crisis. The new Institute has been created with the object of compelling the reorganisation of these industrial organisations which have been seriously affected by the crisis, so that when the revival of business activity occurs they will find themselves in the best possible condition to take full advantage of it.

Institution of Engineers and Shipbuilders in Scotland.

AT a general meeting of the Institution of Engineers and Shipbuilders in Scotland last week, Professor John Dewar Cormack was elected President in succession to the late Mr. Archibald Gilchrist, who died on December 22nd last. In his election as President, Dr. Cormack follows in the footsteps of several of his predecessors in the Chair at Glasgow University, which he has himself occupied for the last twenty years. For a number of years the new President has been a councillor and Vice-president of the Institution. Educated at the Academy, Dumbarton, and Glasgow University, he later graduated with distinction in engineering. After acting for some years as assistant to Professor Barr, he was appointed lecturer on electrical engineering when a lectureship of that subject was founded. He became Professor of Mechanical Engineering at University College, London, in 1901, and in 1913 succeeded his former chief, Professor Barr as Regius Professor of Civil Engineering and Mechanics at Glasgow University. During the war Professor Cormack was Chief Contracts Officer of Military Aeronautics, and later Assistant Director of Aircraft Equipment and Assistant Controller, Aeronautical Supply Department. Among many of the honours which he received was that of a Chevalier of the Legion of Honour which was conferred upon him by the French Government.

Barclay, Curle's New Dock.

ALTHOUGH it was intended to open formally Barclay, Curle and Co.'s new graving dock at Elderslie on Monday, January 16th, and a distinguished company assembled on board the Blue Funnel liner "Ulysses," the dense fog which prevailed prevented the passage of the ship up the river, and the ceremony had therefore to be cancelled. The "Ulysses" was, however, safely docked on Thursday last, January 19th, and she will undergo overhaul and painting before leaving for a lengthy pleasure cruise on February 11th. As she entered the basin the bow of the ship cut a silken red, white, and blue rope stretched across the entrance, thereby marking without further ceremony the official opening of the new dock. The dock, which was constructed by Sir Robert McAlpine and Sons, has a length of 620ft., an entrance width of 85ft., and a depth from sill to cope level of 36ft. A particular feature in its design is the "Box" gate, so named after its inventor, Mr. Edward Box, M. Inst. C.E., of Newcastle, which is a single-leaf gate with the hinge or keel running horizontally across the sill. The gate, its lifting and lowering gear, and the fitting-out crane were all supplied by Sir William Arrol and Co., Ltd., of Bridgeton, and Parkhead. The completion of the new dock marks a further stage in the reconstruction scheme at the Elderslie Dockyard of Barclay, Curle and Co., Ltd., which includes the construction of a fitting-out wharf, which will cover over 1000ft. of river frontage. A new wharf is being constructed on the east side of the graving docks, while on the west side the quay wall is to be strengthened. When this work has been completed the company will be in a position to handle for overhauling and repairs an aggregate of over a million tons of shipping annually.

British Kromhout Oil Engines.

AN announcement which will be of interest to oil engine builders and users is made by Perman and Co., Ltd., of London, which firm has since 1905 held the selling and manufacturing rights of Kromhout engines throughout the British Empire. Messrs. Perman have now entered into an agreement with John G. Kincaid and Co., Ltd., of Greenock, for the sole manufacture of British Kromhout engines for both marine and stationary purposes. In the past Kromhout engines have been made by the Kromhout Engine Company, of Amsterdam, from the smallest sizes up to 500 B.H.P., but Messrs. Perman are collaborating with Messrs. Kincaid to increase this range by the addition of a new type of engine of larger cylinder capacity than those now marketed, which will be adapted for coasting vessels, trawlers, and similar services, both for main propelling and auxiliary purposes. The specialised plant laid down for the manufacture of oil engines by John G. Kincaid and Co., Ltd., is both extensive and up to date, and it is expected that the agreement will bring considerable work to Greenock. The selling rights for the Kromhout engine are to be retained by Perman and Co., Ltd., which will deal with all inquiries.

Waterloo Bridge.

AT a meeting of the London County Council, held on Tuesday, January 24th, it was decided to extend the contract granted to Sir William Arrol and Co., Ltd., for the maintenance of the temporary Waterloo Bridge and the support of the old bridge for another year. Sir Percy Simmons, the Chairman of the Improvements Committee, read a letter received on Monday last from the Ministry of Transport, which says that, after giving the matter full consideration and taking into account all the views expressed in Parliament and elsewhere, His Majesty's Government had come to the conclusion that there was no alternative but to proceed to recondition the existing bridge and widen it by corbelling, at an estimated cost of £685,000, as set forth in the engineers' report. The further suggestion was made that the question of the design to be adopted for the corbelling out of the bridge to take four lines of traffic should be referred to the Royal Fine Art Commission for its advice. The Ministry is prepared to make a grant of 60 per cent. of the approved cost of reconditioning the bridge on these lines. In conclusion the Minister of Transport said that His Majesty's Government appreciated the spirit in which the Council had conducted its negotiations and the readiness which it had shown to meet the many difficult positions which had arisen. Sir Percy Simmons said that the matter would be dealt with at the next meeting of the Committee or, if necessary, at a special meeting. He could safely say that the Council would require from the Government some assurance that there would be no possibility of the recommended scheme being turned down by Parliament later in the year.

Telephone Statistics.

SPEAKING at a luncheon of the Coventry Chamber of Commerce on Thursday, January 19th, the Postmaster-General, Sir Kingsley Wood, said that the general statistics of telephone development showed that in 1931 the total number of telephone stations throughout the world was about 35,169,000. For the first time in the history of the telephone, that year showed a decrease of about 174,000 instruments. The principal loss was in North America, where the diminution in stations amounted to no less than 550,000. Europe, on the other hand, showed a gain of 400,000, or nearly 4 per cent. of its total. In 1931 the United States was still at the head of the list of telephone-using countries, with Canada second, New Zealand third and Denmark fourth. Although Great Britain was tenth on the list, he was glad to say it was second among the ten telephonically densest countries, both in absolute growth and in percentage growth over the period of the last five years. Great Britain was easily first in the world in absolute growth during 1931. The present indications were that the world figures for 1932 would be even more unfavourable than they were in 1931. Up to September last the United States appeared to have lost a further 1,500,000 telephones, and it was improbable that Europe had made sufficient progress to counterbalance that loss. There was, in fact, another heavy decrease in Germany, and responsible observers estimated that the 1932 figures for the whole world would show a reduction of something like 2,000,000 telephones. Under the conditions, the net increase of 63,300 telephones in Great Britain during 1932 could not be regarded as unsatisfactory, although there was still much leeway to be made up. At the end of the year Great Britain had secured a total of 2,133,000 exchange telephones, and during the year the exchanges increased by 206 to 5270 and the number of call offices by 2200 to some 38,950.

Railway Wages.

As recorded in last week's Journal note, the railway companies have communicated with the trade unions stating that they are prepared to accept the finding of Sir Harold Morris, the Independent Chairman of the National Wages Board. At a meeting held on Tuesday last, January 24th, the Executive Committees of the three railway unions—the National Union of Railwaymen, the Associated Society of Locomotive Engineers and Firemen, and the Railway Clerks' Association—met together to consider the companies' request that the unions would also accept the Chairman's report, which would mean a reduction in wages of about £800,000 a year. It was decided at the meeting to return an unequivocal refusal. The reply will, however, we are given to understand, not raise any other matter. It seems likely that the union executives will await what action the companies may decide to take before they put forward any possible alternatives. In any case, it is not expected that the exchanges of opinion between the companies and the unions will be terminated for the present, and it is probable that further developments will take place.

The British Steel Industry.

THE thirteenth annual dinner of the London Iron and Steel Exchange, which was held on Tuesday evening last, at the Dorchester Hotel, was a very successful event, and over 200 members and guests attended. The chair was taken by Mr. Frank Baxter, the Chairman of the Management Committee, and Lord Leverhulme replied to the toast of "The Exchange." In his speech he stressed the necessity of supplying cheap British steel and semi-finished steel, both for this country and for export. Responding for "The Visitors," Mr. Charles Mitchell, the chairman of Dorman, Long and Co., Ltd., and of the National Steel Committee, said that the home trade of the industry only represented about 30 per cent. of the total trade, and that the remaining 70 per cent. was made up of exports and sales to other nations. The National Committee was endeavouring to discover ways and means to consolidate the industry and to organise it in such a way that it could hold its own in the world's export markets. The Committee had gained courage and inspiration from the support given to it by Sir George May and his colleagues of the Imports Duties Advisory Committee. He looked forward to the time when the British steel industry would again lead in the iron and steel trades of the world. Sir George May, who also spoke, reminded those present that while the industry had got to put its house in order, other steel-producing countries of the world had been doing the same thing. He thought that the industry would put up to the Government a successful reorganisation scheme. If steel manufacturers did not do it themselves, then someone else would have to do it for them, and they would not be in such a happy position as if they had done it themselves.

Frozen Live Rails.

THE difficulties occasionally experienced by the Southern Railway Company in running its electric trains during the recent severe frost have drawn attention to a matter which is well known to electrical engineers and to which no little thought has been given. It is fully appreciated that a disadvantage of the third-rail system of electric traction is the rare possibility that snow or frost may freeze over long stretches of line. During a normal frost it is quite usual to keep trains running throughout the night in order to prevent the freezing over of the third rail, and in general circumstances this practice, combined with the use of various devices such as a wire brush, has proved quite effective. What happened last week between Three Bridges and Brighton and also on the Caterham line, Dartford loop, and Windsor lines was the phenomenon, quite unusual in this country, of rain freezing as it fell and forming an ice crust on the top of the live rail. The layer of ice causes the shoe to make contact with the rail, with the result that surges of current which open the circuit breakers are set up. The occurrence, although comparatively rare, is one which has received, and is still receiving, the careful attention of electrical engineers.

Burrard Bridge, Vancouver.

By J. R. GRANT, Consulting Engineer, Vancouver.

THERE has recently been completed in the City of Vancouver, British Columbia, a high-level highway bridge, with a 60ft. roadway for vehicular traffic, two 8ft. 6in. sidewalks, and a length of 2817ft. 6in. between abutments. The bridge crosses the entrance to False Creek, the city's secondary harbour, and connects the principal business district with the large residential area south of English Bay.

As shown by the aerial view, Fig. 1, the bridge

FIG. 1—AERIAL VIEW OF THE COMPLETED BRIDGE

occupies a very prominent situation, being visible for many miles at sea and from many points in the city and the surrounding area. The suggested site for the Civic Centre is at the north end of the bridge, and it is proposed that the Indian Reserve at the south end should be developed as a park. The desire to secure a monumental public structure, therefore, was one of the governing considerations in the design. Provision had to be made for a future lower deck double-track railway structure to carry the railway and street-railway traffic at present using the adjoining trestle bridge, which seriously interferes with navigation. It was necessary to provide a 90ft. clearance for navigation over the channel situated close to the north shore. These conditions governed the arrangement of the central portion of the structure, which, as shown in Fig. 2, consists of four deck truss spans and a through truss channel span, over which vertical curves provide a smooth transition between the 3 per cent. rising gradients on the approaches. Between the abutments and the steel portion of the structure, the bridge consists of reinforced concrete viaducts, having a length of 353ft. on the north shore, and of 1294ft. on the south shore.

Æsthetic Features of the Design.—The symmetrical arrangement of the principal portion of the structure, combined with massive piers, extending to the deck at the junction of the steel spans and the approach viaducts, and with large pylons connected by cross galleries above the roadway at the ends of the channel span, together with deep concrete fascia girders and railings with vertical curves over the channel span, have produced a very imposing effect.

One of the most unusual features of the bridge is the design of the main pylons and cross galleries shown in Fig. 4, page 94. The pylons have a height of 48ft. above the deck, or 146ft. above high water, and are 16ft. wide by 24ft. long, with barrelled and cross-vaulted ceilings over the sidewalks. Over the arched entrance is a precast concrete prow of a boat, with a bust of Captain Burrard as the figure-head on the right and of Captain Vancouver on the left. Floodlights behind the figureheads illuminate the upper portion of the pylons at night. The cross galleries, 61ft. 4in. long and 24ft. above the roadway are supported by two hollow reinforced concrete girders with curved end brackets. The walls above the girders which extend to the bottom of the windows are 8in. thick and the 4in. roof slabs are covered with Spanish tiles, the projecting roof beams being finished with lion heads cast in place. Over the centre of the roadway is the city coat of arms, also cast in place, and above the windows for a depth of 3ft. the concrete is marked off by battens to represent tiles, which are coloured two shades of green by "Dyerome." The *motif* is continued around the pylons by three concrete bands. The grilles on all windows are of wrought iron, painted black. All the structural steel, including that of the channel span seen under the gallery in Fig. 4, is painted a light grey.

Ornamental concrete pylons, 9ft. square, mark the ends of the bridge. They are topped by bronze braziers, 9ft. high, having twelve panels of coloured cathedral glass, and are illuminated by 2500 candle-power lamps. Fig. 5, page 94, shows the pylons at the north end of the bridge. The top of the brazier is 39ft. above the roadway and 66ft. above the bottom of the steps. The lamp standards are spun concrete, square in section, and the architectural treatment harmonises with the pylons and other features of the structure.

On the architectural features of the design the author had the assistance of Messrs. Sharp and Thomson as collaborating architects. They are responsible for many of the features which have helped so much to produce a bridge of outstanding æsthetic merit, worthy of such a prominent situation in a city of exceptional beauty.

Design Loading.—The bridge was designed for a live load of two 20-ton trucks, or alternatively a 30-ton trailer, with the balance of the roadway loaded with a uniform load of 120 lb. per square foot, which uniform load was reduced to 80 lb. per square foot when the loaded length of the bridge exceeded 200ft. The live load for the side walks was assumed as a concentrated load of 5000 lb. or a uniform load of 100 lb. per square foot, reduced to 60 lb. per square foot for a length of 160ft. or more. Provision was made in the design for impact, wind loads, traction, and temperature effects.

Design Unit Stresses.—Ten different classes of concrete were used for the work, with varying size and quantity of aggregate, weight of cement and water ratio, and it was specified that all concrete was to be mixed for two minutes. Class "F" concrete, which contained 650 lb. of cement per cubic yard and 4½ gallons of water per bag of cement, and was used for the columns and deck of the viaducts and slabs of the steel spans, was designed for :—

	Lb. per sq. in.
Direct compression	625
Extreme fibre stress in flexure	940
Shear	50 to 200
Bond in plain bars	100

Abutments, piers and footings were designed for lower unit stresses, corresponding to the different classes of concrete specified. Structural carbon steel, rolled in Great Britain and delivered in Vancouver by boat, was used for the principal portion of the structure, and the design was based on 16,000 lb. per square inch on the net section for tension and corresponding values for other stresses.

Reinforced Concrete Viaducts.—The reinforced concrete viaducts consist of 8½in. roadway and 5½in. side walk slabs, supported by cross beams, fascia beams at the ends of cantilever brackets, and three lines of longitudinal girders, 27ft. centre to centre, and continuous over two, three, or four spans. The deck is supported by reinforced concrete bents with rectangular columns, connected by deep beams with curved haunches and supported on stepped footings founded on hardpan. Of the five spans on the north shore, the longest is 75ft. clear over Beach-avenue. On the south shore the length of the spans varies from 17ft. 6in. to 84ft. clear, as required to accommodate fourteen tracks and the car shops of the B.C. Electric Railway Company, and to make provision for the future double-track railway which will curve east and west from under the viaduct. The same conditions necessitated some of the columns of the bents being placed off centre.

The 84ft. span is the centre one of three continuous spans, the two others being 71ft. 9in. each. The girders are 29in. wide. The depth of the curb girder is 7ft. at the centre and 12ft. 1in. at the columns, the curved haunches reaching to the quarter points. The centre line girders are 3in. deeper and the tension reinforcement consists of 1¼in. round bars, twenty-seven in the end spans and twenty-three in the centre span to provide for positive moment and twenty-eight over the columns to provide for negative moment. The top and bottom bars are bent to provide shear reinforcement adjoining the supports, the maximum length of bar being 90ft.

The free ends of the girders are supported on pin or rocker bearings, the latter being in reservoirs packed with grease. Where the girders are continuous over the columns they are rigidly attached thereto. The expansion joints for the roadway of the viaduct each consist of two angles, one 7in. by 3in. by ½in., the other 7in. by 2in. by ½in., the 3in. leg sliding on the 2in. leg, and each supported by a 4in. angle, one leg of which

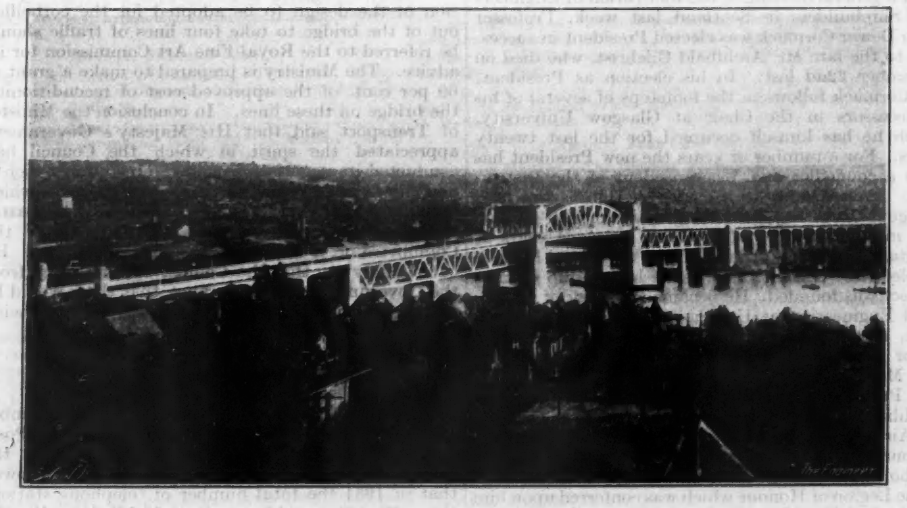


FIG. 2—VIEW OF BRIDGE FROM NORTH-WEST

is riveted to the 7in. leg, the other bearing on the concrete deck to which it is anchored.

The forms for the deck of the viaduct were erected on a working platform supported by timber false-work, as illustrated in Fig. 6, page 94, which shows the construction adjoining Pier 1, where the height from the ground to the crown of the roadway was 94ft., and a load of concrete of about 10 tons per foot had to be supported. All concrete materials were delivered to temporary wharves, adjoining the bridge, containing cement sheds, and sand and gravel bunkers equipped with duplex weighing "Agra-

batchers." The material was dumped directly into trucks, which delivered to paving mixers conveniently situated for the work.

For the construction of the deck and the upper portion of the bents of the south viaduct the mixer was placed at the base of the tower, the top of which is shown in Fig. 6. This tower had a maximum height of 158ft. and, with a steam boiler and hoisting engine, was mounted on timber skids and was moved along a plank roadway 50ft. from the centre line of the bridge as the work on the viaduct progressed. The concrete for the viaduct was elevated by the tower, conveyed by chutes to a hopper and transported and deposited by buggies. The girders, cross beams, cantilever brackets, roadway slabs and a 7in. depth of the curbs were poured monolithically, with transverse construction joints, when required, situated over the bents. The sidewalk slabs, fascia beams and upper

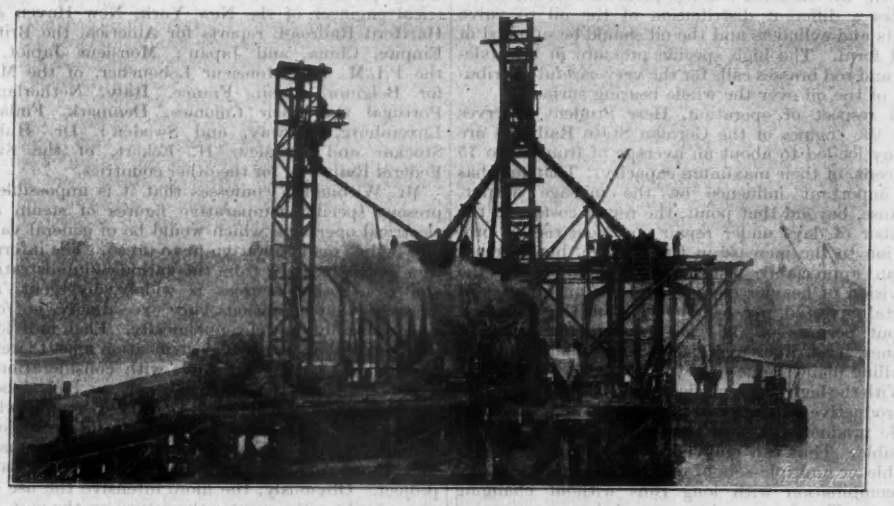


FIG. 3—EQUIPMENT EMPLOYED FOR THE CONSTRUCTION OF THE PIERS

section of the curbs for the full length between the expansion joints were poured in one operation.

Piers.—Provision is made in Piers 1 to 4 for the future lower deck railway structure. Pier 1 at the south end of the steel spans is 22ft. by 92ft. by 111ft. high with all faces vertical. The end walls are 15ft. by 20ft. clear and that on the west contains a stairway from the deck to a path along the railway fill under the viaduct. A cross gallery under the deck renders it unnecessary for pedestrians to cross the 60ft. roadway, and a space is also provided for electric conduits and water pipes, for which provision is made across the steel portion of the structure.

Piers 3 and 4, with bases 42ft. 2in. by 102ft., are founded on sandstone. After the excavation of the sites, which required drilling and shooting to permit the removal of the sandstone with a heavy dipper dredge, the lower sections of timber cribs were anchored in place, built up, and sunk and the foundations were cleaned of all loose and soft material. Fig. 3 shows the equipment used for placing the seal of Pier 3. A timber frame 26ft. high was constructed over the crib, which supported two 10ft. square hoppers and eight 10in. tremies, each hung by a wire rope, which passed over a sheave to one of the winding drums of four hoists.

The concrete from two 1-yard mixers was elevated by the centre tower and delivered by chutes to either hopper. Concrete from a central mixing plant 1¼ miles from the pier was delivered in 2-yard trucks to the left tower, elevated and delivered by chute to the west hopper over the crib. The concrete from each hopper flowed by chutes to four tremies, controlled by operators who were carefully instructed as to their duties. The 2900 cubic yards of concrete required for the seal of Pier 3 were poured in thirty-eight hours, and the 3400 cubic yards required for the seal of Pier 4 were poured in forty-seven hours of continuous operation. Creosoted timber fenders at the ends and along the channel side of each pier are provided for the protection of navigation.

Steel Truss Spans.—The steel portion of the structure consists of one 176ft. and one 216ft. 8in. Warren deck truss span on each side of the channel span. The former has eight and the latter ten panels, and the depth of the chords and also their depth centre to centre are, for æsthetic reasons, the same for both spans. The trusses are spaced at 43ft. centres and the floor beams, which are 5ft. 6in. deep and taper to 1ft. at the ends, are supported on top of the upper chords and cantilever out to support the 80ft. deck.

The trusses of the channel span are the through Pratt type with curved chords. The length is 294ft. 2in. centre to centre of end bearings, divided into ten panels, and the two centre panels of the lower chord are 2ft. above the end panels. The heaviest chord section has an area of 204·3 square inch and the total weight of structural steel in the span is 2,302,000 lb. The trusses are spaced at 65ft. centres, and in order to avoid excessive bending in the truss verticals caused by the deflection of the long floor beams the end connections are set and milled so as to be vertical under full dead load. The ends of the trusses project under the inner corners of the large pylons at Piers 3 and 4 and separate bearings, 3ft. 1in. from the truss bearings, are provided for the girders which support the sidewalks. The 6in. diameter rockers of all expansion bearings for the trusses are immersed in oil, which has a depth of 7in. in water-tight reservoirs.

The structural steel was fabricated in the local plants of, and erected by the Dominion Bridge Company and Western Bridge Company. Except for a small portion at the north end, which had to be delivered by truck, the steel was delivered by scow and erected on falsework towers on pile bents from the south end by a 28-ton traveller mounted on 20in. by 24in. fir skids, 60ft. long, which was assembled on the viaduct adjoining Pier 1. The main, or forward boom of the traveller, had a capacity of 28 tons at 54ft. radius, or 16 tons at 71ft. radius, while an auxiliary boom, 23ft. in rear of the main boom, had a capacity of 3 tons at 60ft. radius. To provide for navigation during erection, a vertical and horizontal clearance of 90ft. had to be maintained. This clearance was provided by the cantilever erection of the four north panels of the through truss span, which required two falsework towers, each consisting of eighteen 12in. by 14in. posts supported by thirty-six fir piles, under the sixth panel point from the south end. Fig. 7, page 94, shows the ends of the trusses supported by hydraulic jacks at Pier 4 before the removal of the blocking at the falsework towers. The auxiliary boom can be seen placing the bracing in rear of the traveller.

The reinforced concrete roadway slabs have a thickness of 6½in., haunched to give 9in. thickness at the longitudinal steel joists, spaced 5ft. and 6ft. centres, to which the slabs are anchored by 2½in. by ⅜in. U bars welded to the joists at 5ft. centres. These U bars support the slab reinforcement during construction. The forms for the concrete deck were supported from the bottom flanges of the roadway joists and the steel lattice girders which reinforce the concrete fascia girders.

Bridge Pavement.—The non-skid roadway surface on the bridge between the abutments consists of 2in. granular surface, Warrenite-Bitulithic pavement, with mastic coves and gutters, 6in. wide and 5½in. high, with the outer surface flush with the upper section of the 12½in. curbs.

Railings.—The railings are reinforced concrete cast in place, 3ft. 8in. high and 8in. thick, pierced by openings, 2ft. 3in. high by 5½in. wide at 12in. centres, and divided into panels by intermediate posts, 2ft. long, with main posts, 4ft. square and 16in. thick, situated over the bents of the concrete viaducts and similarly spaced over the steel deck spans for the support of the concrete lamp standards. The railings are strongly reinforced and anchored to the side-walk slabs and fascia girders. The 1½in. fibre conduits for the electric cables of the lighting system are housed in the plinths of the railings.

Abutments and Approaches.—The abutments are of reinforced concrete, 99ft. 4in. long, that at the north being 34ft. high and at the south 23ft. high. The south retaining walls are 152ft. long and the north 260ft. long, curving to the east and west. Stairways are provided at the north abutment and at the ends of the retaining walls at the south approach. The south approach and railway fill were made by hydraulic dredge with material from False Creek.

Fig. 1 shows the islands for the separation of traffic at the south approach, at the intersection of Cornwall and Cedar streets. The path of traffic to Cedar-street crosses the path of traffic from Cornwall-street, and the movement is controlled by an automatic signal light over the centre of the intersection. Fig. 5 shows the north approach with islands which separate traffic from the west and to the east, *viâ* Pacific-street. The movement of other traffic is controlled by the automatic signal shown at the intersection of Burrard and Pacific streets. The traffic lanes are marked by the through and dummy longitudinal joints in the 9in. concrete pavement. Points on the islands facing traffic are marked by flashing red beacons, 12in. above the curb, and the pedestrian crossings are plainly marked.

Bridge Lighting.—The lighting units for the bridge are 600 candle-power lamps in Westinghouse Paragon units, with Holophane two-way refractors on bronze stands mounted on spun concrete lamp standards, except that the units over the side walks on the channel span and end pylons are supported on bronze brackets. Street hoods, with 600 candle-power lamps, are provided over the centre line on the upper bracing of the through truss span and under the galleries. Besides the floodlights, previously mentioned, 1000-watt floodlights on the fenders illuminate the ends of Piers 3 and 4. These lights, with the navigation lights below the bottom chords at each end of the through truss span, clearly mark the navigable channel. "Lacent" lighting fixtures, manufactured at Wigan, were installed in the Stair Tower, Pier 1. The bridge lighting is controlled from the city street lighting circuit, and the transformer and control equipment is mounted in the gallery and east pylon over the deck at Pier 3.

Quantities and Cost.—The structure was completed in nineteen months, and opened for traffic on July 1st, 1932. It contains 6,760,000 lb. of structural steel, 3,860,000 lb. of reinforcing steel, and 54,000 cubic yards of concrete, and required 16,600 cubic yards of excavation. The total cost, exclusive of land damages and certain work done directly by the city, was 1,844,932·24 dollars.

Personnel.—The combined firms of Hodgson, King and Marble, and Dowson, Wade and Co., Ltd., were the general contractors. Sharp and Thompson were the author's collaborating architects, and Mr. A. J. Leamy was his resident engineer on construction.

The International Railway Congress.

No. II.

(*Continued from page 64, January 20th.*)

SECTION II.—LOCOMOTIVES AND ROLLING STOCK.

MILEAGE OF LOCOMOTIVES.

Section II. of the Congress deals with locomotives and rolling stock and has three questions to consider. The first of these—Question IV.—is "Methods to be used to increase the mileage run by locomotives between two repairs, including lifting." There are three reports under this head and they are by Sir Henry Fowler, of the London, Midland and Scottish Railway, for America, the British Empire, China, and Japan; Herr Student, of the German State Railway, for Germany, Denmark, Finland, Norway, Spain, Netherlands, Portugal and their Colonies, Sweden, and Switzerland; Mr. R. Klatovsky, of the Czecho-slovakian Ministry of Railways, for the other countries.

As was to be expected from one who has had a long experience in the preparation and submission of reports to previous Congresses, Sir Henry Fowler is commendably brief and exact in his present report. He divides the questions he submitted to the administrations he was responsible for under six headings:—Heavy repairs; periodical examination; intermediate repairs; materials, design, &c.; operation; general. On the subject of heavy repairs the report says that the replies show that the necessity for heavy repairs depends chiefly upon the condition of the boiler.

It may be said that, apart from countries where the regulations are governed by those imposed by Government, the condition of the locomotive is ascertained after a certain mileage has been run or a certain period has elapsed. There is, naturally, a great variation in the mileage basis between locomotives on fast and slow services, and, on the whole, the fast passenger locomotives cover a distance between shoppings at least twice that travelled by slow freight locomotives. It must be remembered, however, that there is not only a relation of speed, but also of time in service to be considered, and that, for a definite mileage, the time in steam of a freight engine is generally well over the time for a fast passenger service—except with express freight services which are probably on the increase.

Some railways, chiefly in Great Britain and its Colonies, conduct certain of their examinations on a mileage basis; the mileages are usually multiples of

a thousand, so chosen that these examinations may synchronise as far as possible with those conducted on a time basis. With the boiler, in many cases, an examination each month by the shed staff is supplemented by an examination conducted by an inspector from headquarters every six months. This arrangement tends to give uniformity of treatment.

There is a consensus of opinion that an organised system of periodical examination materially increases the mileage between heavy repairs. It prevents casualties and accidents, and, in many cases, allows material to be prepared in advance, so as to prevent delay whilst the locomotive is out of service for repairs. It is apparently looked upon as one of the most important factors in obtaining the desired mileage between repairs.

The re-turning of the tires and giving attention to the axle-boxes are dealt with at some period between the heavy repairs carried out in the main workshops; in some cases it is stated that tires are, if necessary, replaced. To that work the name of "intermediate repairs" has been given. Although one railway states that the mileage is not increased by an intermediate repair, two others definitely say that an increase of 20 to 25 per cent. of the mileage is the result of an intermediate repair.

Where an opinion is expressed, with regard to the relation between tire and rail to produce the best conditions in service, it is that the tire should be somewhat harder than the rail. In one or two cases preference is expressed for sorbitically treated tires.

As was to be expected, the majority of the replies to the question as to bad feed water influencing the distance run between two heavy repairs, indicate that this feature either influences the distance run between shoppings or entails more work in the sheds to keep the locomotive in service.

Thirty of the forty-one administrations consulted report that they are using or have used mechanical lubrication to a greater or less extent. In the majority of cases it is stated that it has given satisfactory results as far as mileage and repairs are concerned. In six cases it has either been taken off or no extension of its use is being made. Of these latter administrations, all but one are in hot climates.

The method of reducing flange wear by tire flange lubrication is extensively used in North America—with the exception of the Pennsylvania Railway, where rail lubrication is employed on bad curves—although the results so far are not definite.

After summarising the foregoing and other conclusions, Sir Henry sums up thus:—(1) The chief reason for undertaking heavy repairs is the need of repair to the boiler; a proper organisation for regulating heavy repairs is held to be very desirable. (2) A carefully worked-out system of periodical examination prevents failure and casualities, and so eliminates irregular repairs. (3) It is practically always necessary for a locomotive to receive attention to tires, axles, &c., between heavy repairs, and organisation should allow of these taking as short a time as possible. (4) The question of the relation between tires and rail, and the profile of both of these, deserves closer investigation than has at present been given. (5) The quality of the water supplied to a locomotive boiler deserves the closest attention. That has a very material bearing on the mileage between heavy repairs. (6) Every method should be adopted to obtain as great a mileage per day as possible, as the increase of this helps greatly in the total mileage obtained.

The concluding observations in the report by Herr Student say that, in the case of hard-worked engines, safety and economy will be best assured if, in accordance with the Danish plan, a four-yearly internal examination of the boiler is provided for, with which a suitable general repair and examination of the running gear of the engine and tender is coupled, during which the frames are gauged and all parts brought back to original dimensions or according to work limits. In the case of a few engines, a four-yearly internal boiler examination is probably unnecessary and too costly. It is therefore to be recommended that the internal examination should take place at the latest after six years, while, in case of need, it can be put forward. If engines are carefully maintained, the external boiler examination is rendered unnecessary. In the case of new engines, the first internal examination may be deferred until the eighth year.

Excessive wear of particular parts should be made good by intermediate repairs. For the remainder, all work during running repairs—general repairs as well as intermediate repairs—must be carried out with the greatest care and accuracy. During intermediate repairs certain parts of the engine must be periodically examined. While it is certain that such regular attention will appreciably increase the output between two general repairs, the result can naturally only be estimated. There will be controversy in regard to intermediate repairs; in the opinion of the reporter, they are indispensable for economical locomotive operation. It is not, however, economical to entrust regular repairs to engine crews; if that were done, their output and that of the engines would be reduced.

On the subject of design and material, Herr Student remarks that the results of researches carried out by the German State Railways Company do not justify any discrimination betwen braked and unbraked tires, in view of the fact that as many thick tires come slack as thin ones. The introduction of superheating gave rise to considerable difficulties in regard to piston and valve-rod tightness. The soft packings did not offer enough resistance to high temperatures, nor were the soft metal packings satisfactory. Those troubles have been eliminated by a cast iron stuffing-box, wherein the gland and packing rings are made from soft cast iron. These rings remain tight, even when the crossheads are badly worn. For axle-box and rod bearings, the bronze shell, with white metal insets, predominates on the German State Railways and on the other lines covered by the reporter.

A superheat oil is used on the engines of the German State Railways for oiling the pistons and valves of superheated engines. This oil has a flashpoint of about 300 deg. Cent. (572 deg. Fah), and is satisfactory with steam temperatures of 400 deg. Cent. (752 deg. Fah.), and over. The old theory that the flash-point of cylinder oil should be at least as high as the temperature of the steam need no longer be maintained. On the other hand, superheated steam necessitates a different distribution of the oil to valve chests and cylinders and the oil should be supplied in fluid form. The high specific pressure in the axle-box and rod brasses calls for the very careful distribution of the oil over the whole bearing surface.

In respect of operation, Herr Student observes that the engines of the German State Railways are to-day loaded to about an average of from 60 to 75 per cent. of their maximum capacity. That fact has an important influence on the mileage output, because, beyond that point, the repair costs and the number of days under repair no longer rise in proportion to the increase in the mileage, but increase at an appreciably faster rate. Undoubtedly the provision of heavier engines leads to an increase of capital invested per locomotive, but the increased output permits of the use of a smaller stock of engines, and, moreover, less accommodation and handling plant are necessary.

With the high costs entailed by locomotive operation unproductive labour must be kept as low as possible, while productive labour must be raised as much as possible. That can only be achieved by the use of double or multiple sets of men on main line engines, in combination with long runs without changing engines. Turning-round times, and the time occupied in cleaning fires, are of influence on the full utilisation of locomotives. The arrangement of the locomotive yards must be properly thought out on that account, and the approach lines must be arranged to admit of the rapid access of the engines to the sheds, as that makes for saving in men and engine time.

No basic alterations have been made in the locomotive during the last ten years. Nevertheless, during that time improvements have been made on the German State Railways, which have influenced the output. Among these may be mentioned the increase in the dimensions of the highly stressed connecting and coupling-rod bearings, and the improvements in the design of the pressure equalising valves, with the object of reducing compression, and, above all, of destroying the vacuum in the cylinders and valve chests, when the engine is running without steam. That has reduced the fouling of the valves and pistons and increased the intervals between the examinations of those parts. Drop grates and ashpan bottom doors must also be referred to. In addition, trials are in progress with plain and corrugated iron fire-boxes, welding-in of small and large tubes, and the use of repaired fire-box plates and stay bolts, as well as the adoption of higher boiler pressures and the pulverised fuel locomotive.

The recent reorganisation of the repair shops of the German State Railways also had a marked influence on locomotive mileage. Modern machine tools and methods of work, good gauges, and a large provision of spare parts have made it possible to reduce, by about 50 per cent., the time taken for repairs. At the same time, the work is now better and more accurate. The improved equipment of the running shed repair shops and the extra care taken of the engines in them, which, among other things, ensures a high grade of cleanliness, must also be mentioned. Machine tools and gauges have been provided for dealing with the driving and coupled journals, and the driving and coupled crank pins, and, with the aid of these tools, the smallest errors can be discovered and made good.

The summary to the report by Mr. Klatovsky says that the maximum mileage run by a locomotive between two repairs, including lifting of the locomotive, depends chiefly upon the wear of the tires, which, for reasons of safety, should not exceed a predetermined limit. As long as the thickness of the tire is sufficient, the wear of the flanges is the factor deciding the necessity for lifting the locomotive and re-turning the tires. In order to reduce flange wear the Paris-Orleans Railway has used high tensile tires and rails. Some administrations have introduced the lubrication of the rail or of the flange in mountainous districts. No definite opinion can, however, be given as to the utility of these methods at the present time. None of the administrations covered by Mr. Klatovsky's report has carried out tests with a view to discovering a better tire profile, although such tests would certainly be of importance. Until a means for reducing tire wear has been found, the bad state of the tires will still be the chief reason for lifting the locomotive; lifting for any other purpose would be exceptional.

The time taken for repairs has been shortened on some railways by reorganising the work and by controlling it and by standardisation of the parts. Nevertheless, the necessity for reducing the time still remains one of the most important questions of railway operation. One of the measures taken with a view to increasing the daily mileage of locomotives has been the employment of a double set of men; that has proved to be the most effective. Each washing-out of the boiler involves the stoppage of a locomotive for a certain length of time. The modern washing-out plants are to be commended, as they make it possible to reduce the time for this operation by one-half, and they give considerable material economies by utilising the heat of the boiler water when the engine has worked its turn.

Question V. covers "Electrification of railways from an economic point of view; selection of sites for generating stations; choice of the kind of current; safety precautions, &c." Mr. S. Withington, electrical engineer of the New York, New Haven and Hartford Railroad, reports for America, the British Empire, China, and Japan; Monsieur Japiot, of the P.L.M., and Monsieur Leboucher, of the Midi, for Belgium, Spain, France, Italy, Netherlands, Portugal and their Colonies, Denmark, Finland, Luxemburg, Norway, and Sweden; Dr. Huber-Stockar and Monsieur H. Eckert, of the Swiss Federal Railways, for the other countries.

Mr. Withington confesses that it is impossible to present specific comparative figures of steam and electrical operation which would be of general value, and he has made no attempt to do so. The information he has received from the various administrations and from other sources is widely divergent, and indicates that conditions vary exceedingly, not only geographically, but chronologically. Each individual example of any proposed electrification must therefore be analysed with great care, with consideration of local conditions and of such items as fuel, labour, finance, power supply, &c. Density of traffic, which is a measure of factor-of-use of the facilities employed in electric traction, is, other things being equal, a measure of the direct return from any electrification project. Obviously, the more intensive the use of a given facility, the greater the return on the cost.

Improvements are constantly being made in steam and internal-combustion locomotive design and construction, as well as in electrification standards. It is a temptation of conservative railway managements to await ultimate developments before deciding upon policy. Such philosophy is not readily defensible, and, if widely adopted, would result in serious stagnation of progress.

Each of the heavy electrification projects already installed is satisfactorily functioning, and has, without doubt, fulfilled the economic and operating requirements under which it was installed. While many of these existing electrifications were originally started as solutions for some local problem, a number of them have been extended in scope and territory to take advantage of general broad economies, and it is probable that the installation of electric traction projects will show increasing growth as time goes on.

An important consideration in selecting the position of any power plant is the accessibility for operators and materials. The hauling of heavy machinery which is utilised in power plant installations is a very serious question, unless adequate and economical means for handling such weights are provided. It is also important to remember the *personnel* which will operate the plant. Since the service is normally on a 24-hour basis, two or three shifts or watches are usually employed for each operating duty, and a considerable number of employees must reach and leave the plant every day. A factor in the selection of a site for a steam power plant is the possible criticism from the neighbours, owing to smoke, cinders, and noise, especially in urban or suburban territory. The item of noise also applies to the internal-combustion engine plant.

Either A.C. or D.C. systems of distribution may be supplied mainly from outdoor sub-stations, if desired. Commercial power supply, for high-voltage A.C. distribution, may be concentrated at one sub-station or at two or more widely spaced sub-stations, utilising rotary frequency changers of the capacity required, delivering power at any chosen voltage and stepping-up the voltage for transmission along the railway right of way, for step-down at transformer sub-stations along the route. If D.C. distribution of power is adopted, the sub-stations, other things always being equal, are usually spaced more closely together than with A.C. distribution, on account of the relatively lower voltage utilised, up to the present, for D.C. distribution. This characteristic may be of importance under certain local conditions, and may be of no importance whatever under other circumstances. The power transmission circuits may be installed along the right of way of the railway or across country, if the railway route is tortuous—feeding the sub-stations in turn; or the power may be supplied to the railway sub-stations from neighbouring commercial transmission networks, and be changed at the sub-stations to the characteristics desired for distribution. It may be said that any sub-station, whether A.C. or D.C., may be operated manually or it may be automatically or remotely controlled.

It is of vital concern that there should be standardisation of system of power distribution and of design

of locomotives and other integral parts of the electrification requirements. To one familiar with the economies which have been made possible by quantity production, especially in such industries as motor car manufacturing, it is obvious that the unit costs of installation of all factors of electrification will be modified very greatly if quantity production can be brought about by general standardisation of design and manufacture. It may be said that in general the choice of the most effective voltage is dependent upon the kind of traffic, weight of trains, and extent of the territory to be electrified. With service consisting of relatively frequent trains over a short route—service analogous to urban rapid-transit operation—low voltage is undoubtedly satisfactory, though it is universally agreed that such voltage is inadequate for general railway operation. As the weight of individual train units—either passenger or freight, increases, and as the electrified territory is extended, it is logical to adopt higher voltage. For heavy trains operating over long distances the maximum practical voltage is undoubtedly the most economical and advantageous.

Report No. 2 on Electrification, by Messrs. Japiot and Leboucher, including, as it does, the experience of France and Italy, is very instructive. It observes that electrifications which are excellent propositions are those of lines on which the whole of the conditions required to assure the financial superiority of electric traction over steam operation are found together. Such lines have the whole or some of the following characteristics :—Severe gradients, many of them long, and numerous tunnels; heavy trains; heavy traffic; excessively high cost of fuel; high labour costs; competition of other companies or of road services; area with water power; essential increase in the power and speed of the locomotives required.

The reporters name some examples of electrification, carried out under the conditions just named, which have been successful, but when we say that these include the Morocco Railways and the Algerian State Railways it will be seen that many are very minor concerns. Three examples from the Northern of Spain are, however, of a higher character. These illustrations, it is observed, show how delicate it sometimes is to judge the advisability of electrifying railways outside certain well-defined cases. It will be realised that many private companies, although aware of the advantages that they would gain from converting part, or all, of their systems, hesitate owing to the large capital expenditure involved, especially when the drawbacks of steam operation are not such as to render electrification urgently necessary, and when the financial results appear to be rather problematical.

Many electrifications have been undertaken on railways on which steam operation would be possible and convenient for some time to come. Some electrification of that class has been done, either by State Railways, or at the instigation of the State. They have been called National, in the sense that the State may encourage them for reasons of public economy—to reduce or suppress the importation of fuel, develop the water resources of the country, employ labour, and create or facilitate the development of the home industry, whilst improving the efficiency of the railways. In France, for instance, the changes subsequent to the war called attention to the desirability of using the available water power. A second factor was that of selecting—or, rather, of standardising—the method of traction.

French Electrification.

The French railways began their programme of electrification by first of all equipping those lines which appeared likely to show some financial saving, or to give promise of it in the future. For those reasons the Midi Company fitted up certain of its lines that carried heavy traffic, such as those from Bordeaux to Irun, and from Toulouse to Dax. That company had had in mind for a long time the electrification of its system, owing to the considerable water resources in the Pyrenees. Those resources were of such an extent as to justify the belief that the power stations would be able to supply, in addition to the power required to work the trains, a large excess of current. Those hopes have been realised.

The electrification of the Paris-Orleans was originally considered—in 1917–1919—as the only possible solution of the problem of the supply of fuel which, at that time, was particularly difficult for all the railways owing to the war. Actually, the decision to carry out the first section of the electrification programme, which had been prepared at that period, was taken almost exclusively with the two following objects in view :—(1) Reduction of the importation of coal, the cost of which had become excessive; and (2) the use of the water power of the Massif Central, then unexploited. Hence, the first section of the work dealt with was the Paris-Brive line. It was one of the most heavily loaded on the system, and, at the same time, that which, geographically, was the best placed for being supplied from the Massif Central water power stations. Moreover, the transmission of high-tension supply for feeding the traction sub-station could at the same time be used to connect the producing area of the Massif Central to the very important consuming centre of the Paris area. The continued increase in wages during the after-war period and the difficulty in the way of recruiting staff for handling the locomotives, as well as for work in the depôts, impelled the company to endeavour to effect a saving in labour which only electrification made possible. The increase of the passenger traffic in the Paris suburbs would have made it necessary, with steam traction, to purchase many locomotives, as well as to do considerable work in the way of providing lines and increasing the size of the stations, which electrification, by the increase in speed and the weight of the trains, rendered unnecessary.

The P.L.M. Company, having decided to electrify, as an experiment, one of the important parts of its system, selected the Chambéry–Modane line, because it should be possible to carry out such experiments under very varied conditions, owing to its easy section at the start, followed by long gradients continually increasing in steepness up to 1 in 33 for the last 15 kiloms.—9·3 miles. As the international express trains run over that line it lent itself to traction tests at high speed over the easy section. On the other hand, the last section made it possible to study electric traction on mountain lines, with regeneration on the descending gradients. In addition, an abundance of energy from hydro-electric stations was at hand. Finally, owing to the importance of the through Franco-Italian traffic and the heavy costs of traction over the upper part of the line, owing to the gradients and the bad quality of the water required for locomotive purposes, electrification should provide valuable savings. Experience has entirely justified these provisions.

Italian Electrification.

Coming, as regards the Italian railways, straight to the results we find the reporters saying that outside certain well-recognised technical advantages the Italian railways consider that the operating costs, including the capital charges on the electrified system, reduced to the virtual ton-kilometre hauled, do not sensibly differ from similar costs on the system worked by steam. The available figures are not, however, uniform or comparable, owing to the very dissimilar characteristics. The electrified system, using three-phase low-frequency current, includes important mountain lines with heavy gradients, over which it is quite certain that steam operation would be under the most unfavourable conditions. Electric traction, on the other hand, finds the conditions to be such as to prove its superiority, even from the financial point of view. If it were possible to establish a comparison between the costs of electric traction and those of steam traction on the same lines and under identical conditions, the results would very certainly be favourable to electric traction, owing to the high percentage of mountain lines included in the railway system as a whole.

The Italian railway officers consider that, in view of the present price of coal and the cost of the fixed installations, the economies alone that electric operation procures are sufficient to encourage its wider application. On the other hand, in the cases of lines on which there are no heavy gradients, they consider that the balance is most uncertain, and to be founded upon theories of intensity of the traffic which do not appear to be justified, either by the present state of transport or by prospects in view of the competition of other methods of transport. The reasons in favour of a vast extension of the electrification of important lines cannot, in consequence, be founded upon a financial comparison between the operating costs alone, but, much rather, on a consideration of indirect advantages, which vary from one country to another.

The electrification of the railways is, in the case of Italy, a vital problem, because it guarantees the independence of a service of particular importance for the defence and economic life of the country. In addition, it contributes to the development of all available sources of water power and facilitates the interconnection of the main power transmission systems. Finally, the Italian railways do not consider that the market price of coal is invariable and think that, at the time for preparing a balance sheet for electrification, possibilities, of a political and economic nature, both local and international, may completely upset the bases of such a balance sheet and result in economies which, in a relatively short period, may make it possible to wipe out the capital cost of the installation. The electrification of the railways, they consider, tends therefore to create a potential richness; the contrary of what occurs with steam traction.

Concluding the review of the financial side of electrification, Messrs. Japiot and Leboucher say that there is no formula by which it is possible to say, in each case, whether it is desirable or not to electrify. It is necessary to select a line or a system which has been electrified and that has the greatest similarity with the line to be considered and then to scrutinise carefully the results of working and therefrom to prepare a balance sheet. The financial situation and the state of the money market play an important part in the development of electrification.

The summary to the report by Dr. Huber-Stockar and Mr. Eckert considers that the operation of large electrically operated lines and their development denote that electrification is satisfactory, not only from the technical point of view, but also from the economic side. The importance of the question of knowing the economic success obtained with electrification increases with the extent of electric undertakings. Progress in the domain of steam locomotives and internal combustion locomotives may retard electrification in some instances, but it may also stimulate progress in the domain of electrification, in particular in the construction of electric motor vehicles. Thus it may not definitely lessen the superiority of electric traction over all other systems of traction from the technical point of view and, consequently, also from the economic point of view.

A more considerable and more rapid development of electric operation depends, to a great extent, upon the degree of conviction with which it can be shown that, of the electrifications which have been carried out, the large electrically operated lines are economically profitable for their administration, either directly in the usual sense, or indirectly by ensuring them, fairly cheaply, the advantages of electric traction. Comparison between the two types of operation cannot alone be the decisive factor, because, for reasons residing in the nature of things, it is affected by some incertitude, and because it does not include great and incontestable advantages of electric traction which do not appear distinctly in the accounts. Arithmetical comparison between the two types of operation—electrical and steam—elucidates, to a large extent, the economic problem relating to electrification, for which reason such comparison should be examined by a larger number of administrations.

It would appear useful for administrations, competent in electric and steam operation, to elucidate the hypothesis and the method to be followed in order to make up an arithmetical comparison between the types of operation. The type of energy supply, in itself, has no decisive influence on the economy of electric operation. The choice of the type depends, in the first place, upon the particular possibilities and circumstances. The location of the power stations is, in most cases, determined by the type of supply, by Nature, and by elementary considerations. The choice of the system has lost its former importance. In many countries it is limited to the systems already in use and dictated by standards. The system employing D.C. below 1000 volts, with third—or third and fourth—rail, has shown itself the best for the electrification of urban and suburban railways. Systems employing D.C. at 1500 and 3000 volts and A.C. single-phase at 15,000 volts, 16⅔ cycles—in America at 11,000 volts, 25 cycles—are the most widely used, and, for some time, have practically been the only systems to be used for extensive electrification. Two instances of electrification have been carried out experimentally with a view to the direct utilisation of industrial current, one of which employs three-phase current at 45 cycles, and the other three-phase current at 50 cycles.

Safety measures have been developed very considerably on all electrified railways. The cost of safety equipment is of no importance in the economic aspect of electrical operation. The economic and moral effect of such equipment is both excellent and considerable. Driving of electric locomotives and rail motor cars by one man is found to be absolutely safe, owing to the improvement in safety devices employed for that purpose.

(To be continued.)

RADIUM IN CANADA.

The chemists of the Canadian Department of Mines have succeeded in concentrating the radium of the ores from the Great Bear Lake from one part in 10 million to one part in 100,000. The concentrate is virtually free from all other impurities except barium, and represents 95 per cent. of the radium present in the original ore. It is not definitely known, but it is believed that in the case of the processes used with United States ore, the concentration at this point was one in one million, whilst that associated with the Belgian Congo ores is one in 200,000, with recoveries of not more than 75 per cent. of the original radium. In addition, the length of time required for the production of radium-barium concentrate has been reduced from three months to two weeks. Nothing now remains but to carry the purification still further to a concentration whereby the radium-barium content may be raised to a strength suitable for medical purposes, and this is standard practice involving no great difficulty. The total time taken in the production of radium concentrates containing 96 to 98 per cent. radium will be three months instead of six months, as in the case of other processes.

Briefly, the process used is as follows :—The pitchblende ore, which has previously been ground to about the fineness of icing sugar, is leached with hot hydrochloric acid and stirred violently for several hours. It is then filtered. The solution now contains uranium and radium, as well as any other metals present. The undissolved part is thrown away. To the solution is added a mixture of barium chloride and sodium sulphate to produce a white precipitate of barium sulphate and lead chloride which contains the radium. A long period of constant stirring—from twenty-four to forty-eight hours—is required in order that complete precipitation of the radium may be obtained. This precipitate is then washed with brine to remove the lead chloride; the radium-barium compound is dried and is then ready for the refinery. At this stage it contains about one part of radium in 100,000.

THE WORKS OF TUBE PRODUCTS, LTD., OLDBURY, NR. BIRMINGHAM

(*For description see opposite page.*)

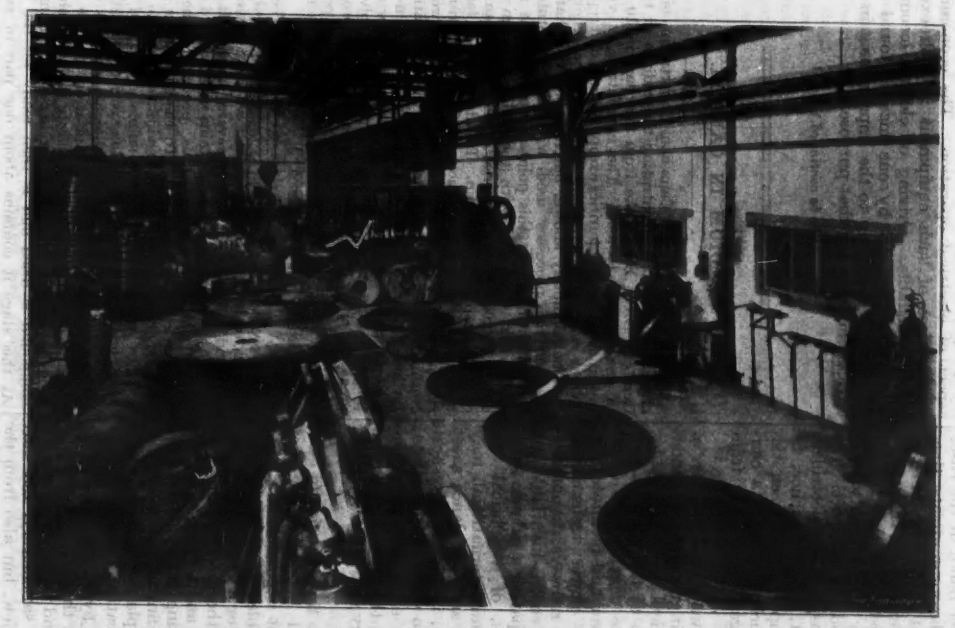


Fig. 1—Several lengths of steel strip are welded together end to end and coiled on plates. They are fed to the machines through the wall.

Fig. 2—The strip enters the machine through forming rollers A; is autogenously welded at B; re-rolled at C, and the tube so formed sawn into convenient lengths at D.

Fig. 3—In this shop a short length of each tube is cut off and tested. The tubes are examined, straightened and coated with oil before going to the store.

Fig. 4—Girls operating special lathes part off the tubes into lengths suitable for later operations, or to the requirements of the customer.

The Works of Tube Products, Ltd.

WHILE visiting Birmingham recently, we had the opportunity to see electrically welded steel tubes manufactured by a process which is, we believe, comparatively new to this country. The process is carried out by Tube Products, Ltd., of Popes-lane, Oldbury At the moment tubes between a minimum of ⅛in. outside diameter with a wall thickness of 0·064in. to 0·024in. up to 2½in. outside diameter with a wall thickness of 0·084in. to 0·048in. are manufactured. The engravings opposite and those accompanying this article illustrate various stages in the process of manufacture, and certain subsequent manipulations of the tubes produced. Steel strip of best quality British manufacture with a carbon content between 0·12 and 0·15 per cent. and a total sulphur and phosphorus content of about 0·04 per cent. is used. This strip is received in the form of coils weighing between 3 cwt. and 5 cwt., and before any other work is done the material in each coil is subjected to an Olsen test and specimen pieces are cut off for chemical analysis. These tests having proved the material to be satisfactoty, each coil is laid upon a rotatable plate mounted on the floor and recoiled either on to another similar plate or on to a drum. While being coiled in this way it is carefully examined for surface defects. Several of the small coils are welded together end to end during the recoiling process to make a coil, ready for passing into the tube making machine, weighing at least a ton and preferably more. If wound on a drum the finished coil is lifted by the crane and taken to the machine-room, but lately the firm has evolved a system of re-winding the coils directly on to the plate, from which they will be fed into the machine. This second arrangement has the advantage that less time is absorbed in placing in position succeeding coils as the earlier ones pass through the machine. The first illustration—Fig. 1, opposite—shows the shop in which these processes are carried out. In the background is the stock of small coils of strip as received and in the right foreground large coils are feeding the machines through holes in the wall. One coil is almost completely unwound and a workman stands ready to weld its end on to that of a coil recently placed in position so that the machine may be delayed for as short a time as possible. Beneath the crane there is another coil ready to take the place of that just exhausted.

On entering the machine, whether from a drum or, as illustrated, from a plate, the strip first passes through a set of circular cutters which trim it to the exact width for the diameter of tube required, giving it at the same time good clean edges for the welding process. Subsequently it passes through a series of rolls, which form it into a close-jointed tube and is guided into position beneath a rotating electrode by a knife-shaped guide bearing against the edges that are to be welded together. Beneath the electrode it is autogenously welded by the resistance method. The slight fin left on the outside of the tube after welding is shaved off by a specially shaped cutting tool on the delivery side of the machine and the welded tube finally passes through a series of finishing rolls which bring it exactly to size and correct any tendency towards an oval or other distorted form. Two views of the machine-room are shown in Fig. 2, opposite, and Fig. 5 respectively. Some of the machines are being fed from drums and some through the wall from plates.

Fig. 5—The Machine Shop: Here the strip passes from drums seen on the right into the welding machines to be formed into tube.

It will be seen that the finished tube is delivered continuously by the machines, whereas for most purposes comparatively short lengths only are required. In order to avoid stopping the machines each time it is necessary to cut off a length of the tube, electrically driven saws—to be seen in Fig. 2—are so mounted as to be able to travel along with the tube as they part it off. Each saw is mounted on a slide. On the pulling of a rod by the workman responsible for cutting the tube into lengths the saw is swung over and "bites" into the tube. It is helped to maintain its position relative to the tube by the workman, who continues to pull the rod. The saw is thus carried along the slides upon which it is mounted. Both slides are set at an angle to the horizontal, but that furthest from the tube has the more pronounced slope, so that the saw is progressively swung over and fed into the tube. At a point beyond that corresponding to the final parting of the tube the more steeply sloping guide of the saw is caused to slope very steeply in the opposite direction, so that the saw falls out of engagement and is allowed to run back down the guides. It is prevented from again feeding into the tube on this return motion by a simple ratchet type of mechanism. The length of tube cut off depends, of course, on the purpose for which it is required, but is usually between 15ft. and 20ft. These lengths of tube pass through the wall of the machine-room into the department illustrated by the photograph reproduced in Fig. 3. Before being loaded on the carriages to be seen in the foreground of this engraving, each length of tube is passed through a straightening machine. Here the finished tubes are carefully inspected and are coated with an anti-rust oil to preserve the bright finish. Short lengths are cut off each tube and subjected to an expansion test, and it is interesting to note that of those few which fracture under this test very few do so at the weld.

From the store the 20ft. tubes are taken as required to the shop shown in Fig. 4. Here they are cut to the sizes required by consumers. As the store is placed between this shop and that in which the last operation of making the tubes is performed, it will be seen that from the time of its arrival as strip the material travels in a straight path, with the minimum of transport, to the exit doors of the works. In the cutting-up department girls using specially designed simply operated lathes part off the tubes to the required lengths. The way in which the number of lengths is counted, though simple, is ingenious. Each girl places every length parted off on to a wooden inclined way, down which it rolls. Halfway down the slope a small catch is depressed by the tube and operates a counter similar in form to the milometer on a push bicycle.

A small section of the works is given up to rolling and drawing the tubes either into diameters not catered for by the machines or into oval, square, triangular, "D" or other useful or merely decorative sections. As made, the tube has a slight projection internally beneath the weld, and in this form it is unsuitable for certain applications. The fin may be removed by cold drawing or swaging.

Besides the shops given up to the actual manufacture of the tube itself, there is another large section of the works concerned with its manipulation and fabrication into various articles. Two photographs of the main shop concerned in this work are reproduced in Figs. 6 and 7. A considerable quantity of the larger sizes of tube is bent into the form of exhaust pipes for motor cars, and a number of such pipes are to be seen in the foreground of one of the engravings. Many of these pipes are of an unexpectedly complicated shape. It is interesting to note that the firm finds that tubes 2in. by 16G annealed can be bent to a minimum radius of 4½in., smaller tubes being capable of taking considerably sharper radii. Amongst other work carried out in this shop, the fabrication of parts for bicycles has been developed on mass-production lines, and the majority of the presses and other machinery to be seen in Fig. 7 are concerned with this work. Parts such as fork sides, for both front and rear forks, the steering column, seat pillars, and even cranks are fabricated.

By the courtesy of the management we were able to see some tubes, chosen at random from stock, tested hydraulically to destruction. The makers claim that by suitably controlling the welding technique the correct heat treatment is given to the weld metal to bring it into the best conditions metallurgically, and that, in fact, the weld is stronger than the parent metal itself. These claims were certainly borne out by the tests we observed. As everyone knows, tubes fail under hydraulic pressure, first by swelling and finally by tearing. In each case—and several different diameters and gauges were tested—the weld withstood the swelling, and the fracture invariably occurred elsewhere than at the weld. Specimens have also been tested in tension by cutting out circumferential strips and similar results have been obtained.

The firm, we learnt, claims that the manufacturing process used ensures a wall thickness varying by no more than 0·002in. throughout, while tests made by its staff have shown that there is no increased tendency for the metal to corrode at or near the weld. The quality of weldability is, of course, ensured by the process of manufacture, and those concerned in subsequently maintaining the product at standard have no need to worry unduly about this important point.

Figs. 6 and 7—The welded tube may be fabricated into a variety of parts. On the left tubes are being bent to form exhaust pipes, whilst on the right machines for manufacturing bicycle parts are to be seen.

The Physical Society's Exhibition.

No. III.

(*Concluded from page 66, January 20th*).

THERMALLY operated maximum demand indicators were among the exhibits of Crompton Parkinson, Ltd. In these instruments two bi-metal strips are fixed parallel to one another, and so that they will deflect in the same direction with an increase in temperature. One strip is heated by the current to be indicated, or a definite proportion of it. The difference in the movement between the heated strip and the strip at or about atmospheric temperature is transmitted through connecting links, a quadrant and a pinion to an indicating pointer which pushes up a separate maximum-demand pointer which remains at the maximum position to which it has been forced, until replaced by hand. New patterns of the Crompton Parkinson "tong test" multi-range ammeter for A.C. or D.C. measurements were shown. Three types of these instruments are now manufactured—an instrument with tongs for encircling cables up to 1⅝in. diameter, a corresponding instrument with reduced iron core section to enable currents up to 200 ampères to be measured, and an instrument with large rectangular tongs for encircling porcelain fuse handles, so that currents may be measured in the various circuits of feeder pillars. A new "A.C. test" instrument operates on the same principle as the "tong test" instruments, but has a longer scale, and it can also be used as a voltmeter.

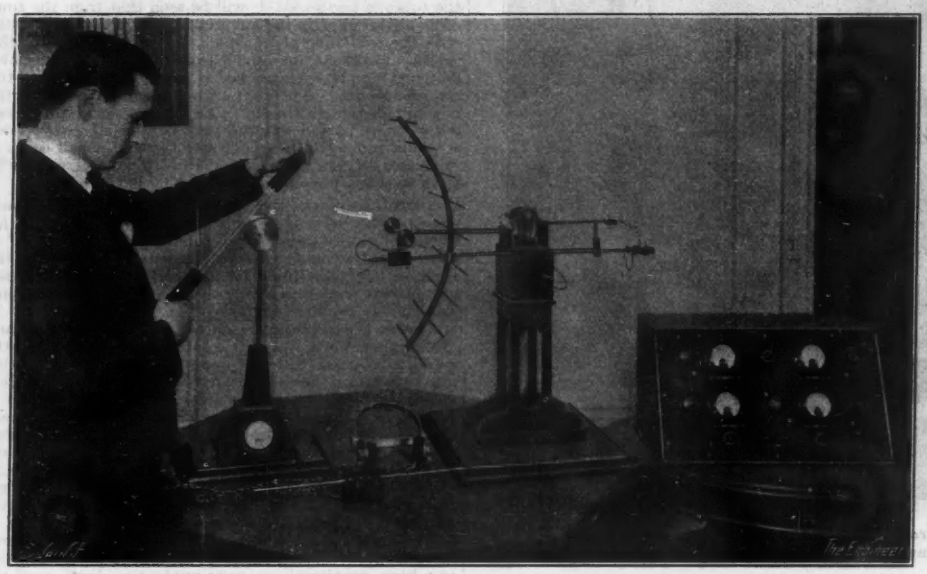


FIG. 23—"MICRO" WAVE WIRELESS TRANSMITTER AND RECEIVER

New wireless apparatus of considerable interest was exhibited by the Marconi Company. The "micro" wave equipment shown in Fig. 23 comprises a transmitter and reflector with control gear, a crystal receiver and measuring apparatus, and is intended to demonstrate the method of generation and the propagation characteristics of electro-magnetic waves of about 50 cm. The transmitter has two valves operating in parallel on the Barkhausen-Kurz principle, and a parabolic reflector which limits the radiation to a narrow beam. The receiver comprises a crystal detector and tuned aerial, signals being received on a pair of headphones. The apparatus demonstrates polarisation, the limitation of radiation to a narrow beam, and wave distribution on wires.

Besides some valve diathermy apparatus, the Marconi company was also showing on its stand an amplifying equipment with a flat response characteristic over a wide band of frequencies, a Marconi marine telephone installation, and an aircraft apparatus for the reception of visual course indicator signals. The latter is for use in aircraft flying along a fixed route. A Marconi wireless beacon emits a continuous wireless signal consisting of a combination of two audio-frequency notes of 65 and 86·7 cycles per second respectively. The receiver receives the two notes at relative strength corresponding to its position relative to the transmitter, and the output of the receiver acts upon two tuned reeds, one having a natural frequency of 65 cycles, and the other 86·7 cycles. Two discs attached to the reeds present to the eye two white lines and the relative lengths of the lines provide a visual indication of the relative strengths of the two notes, and, therefore, of the position of the receiver in relation to the course.

The small insulation testing set shown in Fig. 24, weighing 3¾ lb., was exhibited by the Record Electrical Company, Ltd. The dimensions are 5⅞in. by 4½in. by 5½in. When placed on a table or other support there is ample clearance for turning the handle. The indicator is a true ohmmeter of the cross coil type, with spring jewels, and is dead-beat and direct reading. Immediately the handle is turned the pointer takes up its position, the accuracy of the reading being independent of the speed. Leakage currents between the terminals and internal connections are prevented by a Price guard ring.

Miniature electrical instruments with long circular scales for mounting on small boards on which panel space is limited, were shown by Nalder Brothers and Thompson, Ltd. The instruments consist of reactive kVA meters and voltmeters and ammeters,

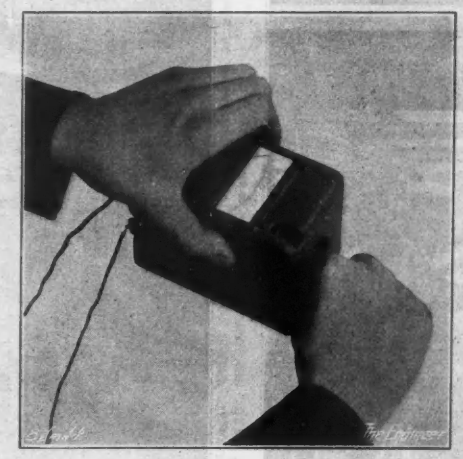


FIG. 24—INSULATION TESTING SET

giving an angular deflection of about 300 deg. and power factor meters with a full 360 deg. scale. The instruments are made with 2½in. and 4in. dials, the former giving a scale length of 5in. and the latter over 8in. The wattmeters, voltmeters, and ammeters are spring controlled, and are fitted with external zero adjusters. The voltmeters can also have "set-up" scales, and the wattmeters and reactive kVA meters centre zero scales. All the instruments comply with B.S.I. specification No. 89 for first-grade accuracy.

A new instrument (Fig. 25), designed for controlling temperatures up to 1400 deg. Cent., was shown by Negretti and Zambra. Special features of the controller are that all the contacts are opened and closed by a synchronous motor embodied in the instrument, and that the contacts take the form of mercury switches. In many cases no relays are required. The instrument operates on the thermo-couple or electric resistance principle, and is suitable for controlling electric furnaces, ovens, &c., or for operating coloured lights. One, two, or three switches are provided according to requirements. When one switch is employed its capacity is 15 ampères at 200 volts, whilst when two or three switches are provided each is rated at 5 ampères 200 volts. The temperature movement in the case of the thermo-couple controller consists of a spring-controlled,

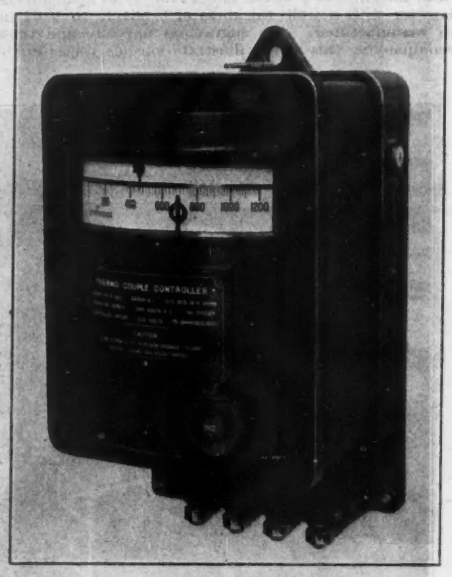


FIG. 25—THERMOCOUPLE TEMPERATURE CONTROLLER

double-pivoted moving coil, with jewelled bearings, and there is an automatic cold junction to correct for air temperature, the device consisting of bi-metallic sensitive strip attached to the hair spring of the indicator pointer. The motor operating the control gear works off a 100–110-volt, or 200–250-volt, 50-cycle supply. In addition to the indicating pointer, there is a setting pointer which can be adjusted to any position on the scale by means of a removable key. Below the indicating pointer and connected to it is a subsidiary flexing pointer with a depressor bar above it, operated by cam wheels con-

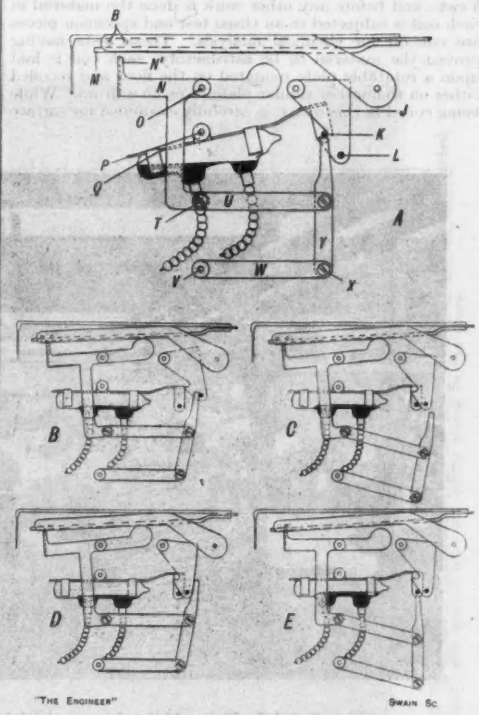


FIG. 26—TEMPERATURE CONTROLLER OPERATING MECHANISM

nected to the motor. Directly below the flexing pointer there are three pallets connected to the three switches. If, for instance, the instrument is used for controlling signal lamps, the centre pallet, which is narrower than the others, represents the correct temperature. The slightest deviation from that temperature will cause the high or low lamp to light. The width of the pallets varies with requirements. The depressor bar, which actuates the control gear, drops for a period of 10 seconds every 20 seconds, and through the medium of the flexing pointer depresses the pallets over which the pointer happens to be at the particular time.

The cycle of operations is shown in Fig. 26. In the sketch A the mercury tube switch mounted on the platform Q, pivoted at P, is in the "off" position and is held by the gravity-controlled detent piece J, which engages with the pin K on the switch platform Q. The detent piece J has a pin L. When the lever N, pivoted at O, is depressed by the bar B and the flexing pointer M strikes the pallet N^1, the striker Y moves to the right and strikes L, thereby moving the detent piece J and allowing the switch carriage to fall by gravity to the "on" position shown in the sketch B in Fig. 26. While the lever is thus depressed, one of the motor cams connected by a push rod to the links W and U allows these links to fall, thus causing the striker to release the detent piece, as shown at C in

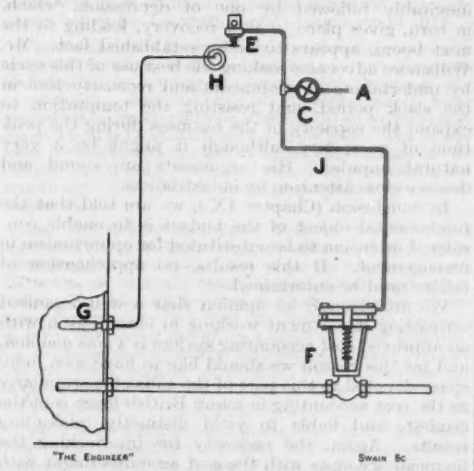


FIG. 27—COMPRESSED AIR SYSTEM OF TEMPERATURE CONTROL

Fig. 26. The cam subsequently raises the striker with its top end clear of the pins K and L, as shown at D. The depressor bar B is then lifted and the pointer is free to move.

This completes the cycle, and the switch remains in the "on" position. Although the lever N is no longer held down by the flexing pointer M, it is not free, as the striker Y cannot move to the left on account of the detent piece J, and if the temperature does not change when the depressor bar next falls, the position shown at D is regained. But if the temperature alters and the flexing pointer M moves so as to be over a different pallet, then when the depressor bar next falls the lever N is not affected and when the striker is dropped by the motor cam the lever N

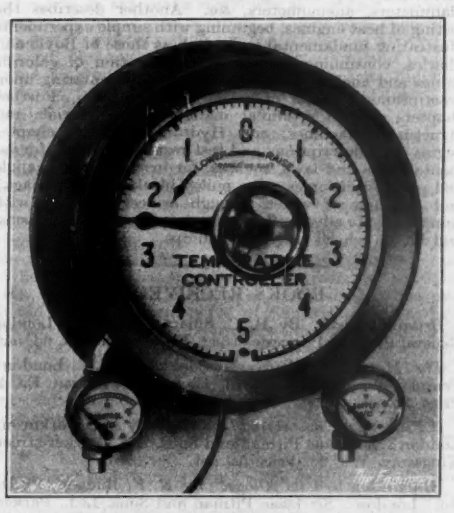


FIG. 28—COMPRESSED AIR TEMPERATURE CONTROLLER

returns to the horizontal position shown in the sketch E, the special construction of the depressor bar allowing the end of the lever N to pass through it. On the upward motion of the links U and W, the striker moves upwards and returns the switch platform to the "off" position, where it is held by the detent piece, as shown at A. There are as many strikers Y as there are mercury switches, and they are all mounted on the same rod, joining the extremities of the links W and U, They therefore all rise and fall together, and replace the switches according to whether their respective levers N have been depressed.

Apparatus for controlling temperature by a sensitive element controlling a supply of compressed air to a valve was exhibited by Negretti and Zambra. The principle of operation is shown in Fig. 27. Compressed air passes through a pipework system in which there is a valve controlled by a diaphragm, the air exit being by way of a leak valve. As long as the pressure in the system remains constant, the position of the valve does not change, but if the pressure varies, it opens or closes according to requirements. The bulb G of the sensitive control element, operating on the mercury expansion principle is placed in the tank or vessel under control, and is connected to the Bourdon tube H in the controller. The diaphragm control valve F is connected in the pipe line carrying the heating medium and is connected to the controller by means of an air line J. Compressed air enters the controller at A and passes to the valve F, C being a restriction valve, which ensures that when the leak valve E is wide open the pressure in the line J, acting on the diaphragm of the valve F, will fall to zero. The leak valve E is adjusted so that the air pressure in the pipe J operating the diaphragm valve F keeps the latter in the required position to maintain the correct temperature in the tank. If this temperature varies, it affects the temperature of the bulb G, and the Bourdon tube H alters its position with respect to the leak valve E, thus increasing or decreasing the air pressure on the valve F and causing it to open or close as required, and increasing or decreasing the supply of heating medium to the vessel.

The air leak valve is a balanced valve with conical seatings which are self-centring without the use of guides. Owing mainly to the special qualities of the mercury-in-steel sensitive element and the design of the leak and control valves, these air-operated controllers are said to work within very fine limits. Indicating and non-indicating air-operated controllers are supplied and an illustration of the latter is given in Fig. 28. This controller can be constructed for temperatures between —40 deg. and 1200 deg. Fah., and is suitable for tanks, pans, ovens, kilns, &c., irrespective of whether they are heated by steam, gas, or hot water, and will maintain the temperature within very close limits without attention. The setting pointer is adjusted by means of a central hand wheel or removable key. There are two air passages with two pressure gauges, one showing the inlet pressure and the other the pressure in the pipe line to the diaphragm control valve. The bulb is connected to the controller by 10ft. of steel capillary tubing. The amount of air required for each controller is 0·5 cubic feet per minute at 15 lb. per square inch pressure. If a mercury switch controller is employed the apparatus can be made to control the flow of an electric current.

The exhibits of the Post Office Engineering Research Station were of great interest to communication engineers, but limitations of space will only allow us to deal with some of them in a general way. An automatic chart analyser shown has been designed to obtain quickly the essential information required in connection with the study of traffic problems in automatic exchanges. The operations of selected switches, numbering up to twenty, are simultaneously recorded by means of an equal number of selected pens which normally trace continuous straight lines on the chart. The occurrence of the operations is indicated by breaks in the lines, the length of the lines being proportional to the duration of the respective operations. The chart of the analyser is passed at constant speed beneath a spot of light focussed on to the normal line by means of a vertical illuminator. Light reflected from the chart is thrown on to a photo-electric cell (Fig. 29), which, through a valve amplifier, controls the grid bias on a thyratron. When a break in the line occurs under the spot of light, the increased illumination of the photo-electric cell causes the thyratron to discharge, and as its anode is fed with 50-cycle A.C., a pulsating D.C. follows and drives a uniselector at the rate of one revolution per second while the discharge continues. The total number of revolutions made integrates the time of the passage of the various breaks under the spot of light, and thus the total time of operation of the particular switch, whilst a slow-acting relay in the thyratron anode circuit counts the number of discharge periods, and consequently the number of switch operations. In the diagram, Fig. 29, batteries are shown for the sake of clearness, but the actual circuit is operated entirely from the A.C. mains.

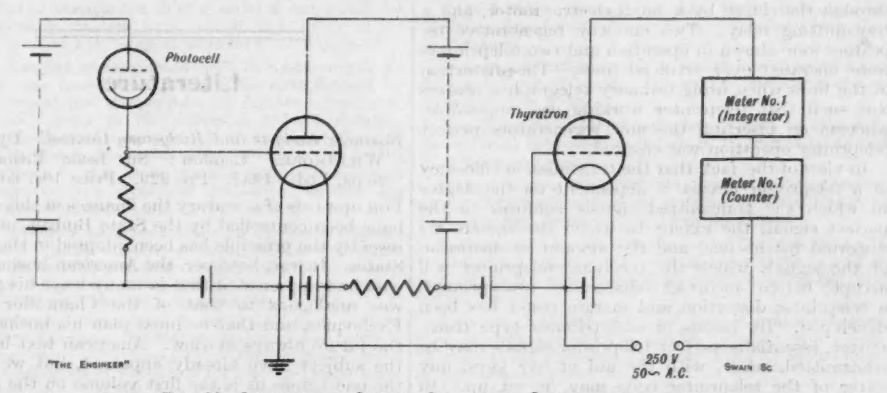


FIG. 29—AUTOMATIC CHART ANALYSER CONNECTIONS

Demonstrations of the precision heterodyne oscillator, illustrated diagrammatically in Fig. 30, showed that this form of audio-frequency signal generator can operate almost perfectly over the audio-frequency range. The frequency error was shown to be less than 0·2 per cent., and it is said that the error is not exceeded by more than 1 cycle per second during a period of many days. The harmonic produced is normally very small, and can be reduced to below 0·3 per cent. of the fundamental signal voltage by means of a device which corrects for the distortion associated with the valve amplifiers and rectifiers, due to the curved nature of the anode current/grid voltage characteristic. The perfection of the apparatus in this respect was demonstrated in a striking manner by comparing the harmonic with that produced by a normal triode oscillating circuit. The apparatus is claimed to provide a really reliable and constant source of audio-frequency voltage for tests on telephone and music circuits and amplifying apparatus.

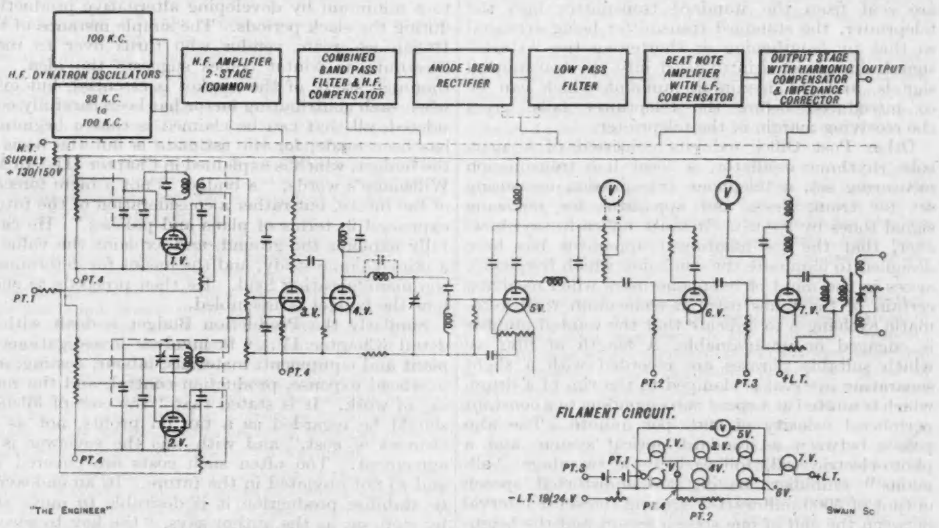


FIG. 30—PRECISION HETERODYNE OSCILLATOR CONNECTIONS

Another Post Office exhibit was a regenerative repeater for teleprinter systems. In telegraphy a regenerative repeater accepts distorted signals and re-transmits them essentially free from distortion. Such repeaters are well known to those associated with cable telegraphy work, but they are costly and complicated, and are only justified on long and expensive circuits. The comparatively simple form of regenerative repeater exhibited has been designed

for teleprinter circuits, and should extend the field of teleprinter systems by permitting the use of longer line sections, by permitting the introduction of a long chain of repeater sections, as on long international circuits, and by allowing an end repeater to be employed in certain circumstances for increasing the margin on critical circuits. It will also extend the field of the teleprinter by permitting of the switching together of a number of independent circuits in order to provide "broadcasting facilities," and by considerably extending the range of point-to-point teleprinter working, while, if used at radio terminals, it will eliminate the effect of distortion in the radio link when using "start-stop" apparatus. The type of repeater exhibited consists of little more than an electro-magnet which actuates a start-stop clutch in response to the incoming signals, a segmented drum driven through the clutch by a small electric motor, and a transmitting relay. Two one-way regenerative repeaters were shown in operation and two teleprinters were operated over artificial lines. The distortion in the lines when using ordinary telegraph repeaters was such that teleprinter working was impossible, whereas on inserting the new regenerators perfect teleprinter operation was ensured.

In view of the fact that the transmission efficiency of a teleprinter circuit is dependent on the degree to which the transmitted signals conform to the perfect signal, the extent to which the signals are distorted in the line, and the amount of distortion of the signals which the receiving teleprinter will accept before incorrect characters are printed, a teleprinter distortion and margin tester has been developed. By means of a distributor type transmitter, essentially perfect teleprinter signals may be transmitted, while, with the aid of five keys, any letter of the teleprinter code may be set up. In order to test a line the received signals are caused to operate a relay which is arranged so that a flash of light is produced on a stroboscopic disc each time the relay tongue moves on to one or the other of the contacts. The flashes are produced by a neon lamp, which makes one revolution for each letter transmitted and thereby shows the relative proportion of each element composing the signal, the amount of distortion of each signal element being read on a scale. The quality of the signals given out by the teleprinter transmitter is ascertained by causing them to produce flashes on the stroboscopic disc when any irregularities can be detected. Alternatively, the teleprinter signals may be compared with those given out by the standard transmitter. For this purpose the separate trains of signals are sent into the opposite arms of a bridge, the galvanometer of which gives a reading dependent upon the inaccuracies of the teleprinter signals. In order to test the receiving margin of a teleprinter, signals are sent from the standard transmitter into the teleprinter, the standard transmitter being arranged so that by lengthening or shortening the "start" signal, distortion is introduced into the transmitted signals, and the maximum amount which can be so introduced before the teleprinter fails, gives the receiving margin of the teleprinter.

Other Post Office exhibits consisted of a neon tube rhythmic oscillator, a local line transmission measuring set, a telephone transmission measuring set for trunk lines, and apparatus for replacing signal tones by speech. It must suffice to say, however, that the last-mentioned apparatus has been designed to eliminate the confusion which frequently arises in the mind of telephone users when receiving certain of the tones used in connection with automatic exchanges to indicate that the wanted number is engaged or unobtainable. A length of film on which suitable phrases are recorded with a slight separating interval is clamped to the rim of a drum, which is rotated at a speed corresponding to a constant peripheral velocity of 90ft. per minute. The film passes between a standard optical system and a photo-electric cell, followed by a two-stage "all-mains" amplifier, having an undistorted speech output of 5000 milliwatts. During the short interval between the end of one speech record and the beginning of the next, the output is passed alternatively to one or the other of two transformers, by means of a cam-operated change-over switch, and from the secondary windings of these transformers the words "number unobtainable," or "number engaged," are passed to the exchange wiring instead of the usual tones.

New types of mercury switches were shown by Isenthal and Co., Ltd. There were single-way and change-over switches designed for all currents from a few milli-ampères at high voltages up to 50 ampères at domestic voltages, and a considerable number of special multi-contact switches designed to meet different requirements. The modern solenoid or non-tilting type of switch was also shown, together with mercury switch relays. As is well known in the ordinary non-tilting mercury switch an electro-magnetic solenoid moves a displacer core and thereby raises or lowers the mercury level and so closes or opens the circuit. Another type of non-tilting switch for relatively small loads is shown in Fig. 31. It consists of a cylindrical tube with the usual mercury cups, contact being made by a light iron rod or bridge resting on the mercury pools. The bridge is acted upon by an electro-magnet with its poles close to the upper surface of the glass tube, and when it is excited it lifts the strip of iron away from the mercury and thus breaks the circuit. In the particular switch shown there is an inner protective sheath. Several types of thermostats were exhibited, all having mercury switches and suitable for controlling living-room temperatures, &c. The most novel exhibit on this firm's stand was a new automatic humidity controller, illustrations of which are not, however, at present available.

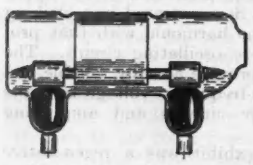


FIG. 31—MERCURY SWITCH

Literature.

Business Budgets and Budgetary Control. By A. W. WILLSMORE. London: Sir Isaac Pitman and Sons, Ltd. 1932. Pp. 229. Price 10s. 6d. net.

FOR upwards of a century the finances of this country have been controlled by the State Budget, and more recently the principle has been adopted in the United States. It was, however, the American business man who first appreciated that in many ways his problem was analogous to that of the Chancellor of the Exchequer, and that he must plan his business with the future always in view. American text-books on the subject have already appeared, but we believe the one before us is the first volume on the application of budget control to business as far as this country is concerned. This makes it all the more welcome.

To summarise the problem, the application of budget principles to business involves not only a careful consideration of the future, so that reliable plans may be formulated, but also the co-ordination of all activities, and, finally, the definite establishment of a system that will ensure the plans being put into effect. Having digested the proposals of the author, we are convinced that the introduction of a scheme of budget control would produce considerable advantages to a company, as it would teach it a great deal more about its own business, quite apart from the gains definitely sought!

After a general survey of the problem in Chapter I., the author proceeds to discuss the Sales Estimate (Chapter II.), and describes the factors affecting future sales, which he reviews in the light of past results, and also takes into account such bugbears as "seasonality," which, he suggests, must be reduced to a minimum by developing alternative production during the slack periods. The simple instance of the Italian ice-cream vendor who turns over to roast chestnuts as winter comes suggests the idea. A thorough study of the market is essential, but even when each contributing factor has been carefully considered, all that can be claimed is that a beginning has been made, for the estimate is but the basis of the budget, which is explained in Chapter III. In Mr. Willsmore's words, "a budget is not a mere forecast of the future, but rather a consideration of the future expressed in terms of plans and policies." He carefully explores the ground, and explains the value of a price-volume study, and the means for determining the manufacturing load. He then proceeds to show how the budget is assembled.

Similarly the Production Budget is dealt with in detail (Chapter IV.). It involves investigations of plant and equipment, materials, labour, costing, and overhead expense, production control, and the routing of work. It is stated that "the cost of idleness should be regarded as a tax on profits, not as an element of cost," and with this the reviewer is in agreement. Too often such costs are covered up, and so not obviated in the future. In an endeavour to stabilise production it is desirable to move step by step, or, as the author says, "the key to success is often *festina lente*." We notice in the description of production planning Mr. Willsmore speaks of the "planning clerk," but we hope this is merely a slip, for we are convinced that this is essentially a post for a man with considerable technical experience. It is asking for trouble to put a clerk in charge of planning.

Chapter V. is occupied with the Expense Budget, in which category will be found direct and indirect producing costs, selling and advertising expense, shipping and packing, auxiliary expense, and administrative expense, each of these main items being appropriately subdivided. Rather an interesting new attitude towards profits is mooted. It is conveniently expressed by the formula: Sales minus desired profits equals allowable costs and expenses; rather than the more familiar one: Sales minus costs and expenses equals net profits. We should like to know how this works out in actual practice.

The financial budget is given careful consideration (Chapter VI.), and the value of the balance sheet, not so much as a record of the past but rather as affording an insight into the future, is emphasised.

When we turn to the administration of the budget (Chapter VII.) we are introduced to a new official, styled the "budget officer," but we are surprised to learn that "his exact status does not matter," for our experience is that new schemes suffer severely when their operation is entrusted to an official whose status does not appear to warrant his meeting heads of departments on an equal footing. The value of co-operation is stressed, and one of the first moves of the budget officer should be carefully to explain the scheme to all concerned, not ignoring the humblest servant of the company. The number of reports which it is claimed should be made at first glance appears to be truly formidable, but when we find that most of them can be expressed graphically by charts that are readily understood, we are somewhat reassured!

The desirability of forward planning is pointed out (Chapter VIII.), and the examination of the business cycle is most instructive. That a boom period is inevitably followed by one of depression, which, in turn, gives place to slow recovery, leading to the next boom, appears to be an established fact. Mr. Willsmore advocates making the best use of this cycle by undertaking developments and reconstruction in the slack period, and resisting the temptation to expand the capacity of the business during the peak time of prosperity, although it might be a very natural impulse. His arguments are sound and deserve close attention by industrialists.

In conclusion (Chapter IX.), we are told that the fundamental object of the budget is to enable considered intention to be substituted for opportunism in management. If this results, no apprehension of failure need be entertained.

We are strongly of opinion that a well-organised estimating department working in close liaison with an approved cost accounting system is a *sine qua non*, and for this reason we should like to have seen more space devoted to this part of the subject, particularly as the cost accounting in many British firms is of the crudest, and liable to yield distinctly misleading results. Again, the necessity for interlocking the financial accounts with the cost accounts might with advantage be developed.

Altogether, "Business Budgets and Budgetary Control" is both suggestive and constructive, and the author is to be congratulated on having produced a work that is a valuable addition to the literature already available on the organisation on modern lines of British industrial undertakings.

SHORT NOTICES.

Experimental Engineering Science. By Nelson Harwood, B.Sc., A.M.I. Mech. E. London: Sir Isaac Pitman and Sons, Ltd. 1932. Price 7s. 6d. net.—This small book of a handy size for carrying about is intended principally for the use of students preparing for national certificates in mechanical engineering. It deals with laboratory work of various kinds in a clear, straightforward style, and includes a chapter descriptive of instruments such as thermometers, pressure gauges, extensometers, indicators, planimeters, anemometers, &c. Another describes the testing of heat engines, beginning with simple experiments illustrating fundamental laws, such as those of Boyle and Charles, continuing with the determination of calorific values and analyses of flue gases and later entering upon descriptions of tests of actual heat engines. Further chapters deal in a similar manner with Materials and Structures, Machines, and Hydraulics. Each chapter begins with descriptions and test results of simple fundamental rules and laws, such as, for instance, the triangle and polygon of forces; the pulley block and screw jack; and the flow of water through orifices; ending with comparatively advanced testing of materials, mechanisms, and Pelton wheels and water pumps.

BOOKS RECEIVED.

Britain's Peril. By R. C. Smart. London: London General Press, 6, Bouverie-street, E.C.4. Price 3s. 6d. net.

The Motor Ship Reference Book for 1933. London: Temple Press, Ltd., 5–15, Rosebery-avenue, E.C.1. Price 5s. net.

A First Year Engineering Drawing. By A. C. Parkinson. London: Sir Isaac Pitman and Sons, Ltd., Parker-street, Kingsway, W.C.2. Price 5s. net.

Aluminium and its Alloys. By N. F. Budgen, Ph.D., &c. London: Sir Isaac Pitman and Sons, Ltd., Parker-street, Kingsway, W.C.2. Price 15s. net.

Principles of Industrial Management. By E. A. Allcut, M.Sc. London: Sir Isaac Pitman and Sons, Ltd., Parker-street, Kingsway, W.C.2. Price 10s. 6d. net.

Textile Electrification. By Wilhelm Stiel, translated by A. F. Rodger. London: George Routledge and Sons, Ltd., 68–74, Carter-lane, E.C.4. Price 63s. net.

Electrical Engineering Manual. By S. Parker Smith, D.Sc., &c. London: Oxford University Press, Amen House, Warwick-square, E.C.4. Price 3s. 6d. net.

Calculus for Engineers and Students of Science. Second edition. London: Sir Isaac Pitman and Sons, Ltd., Parker-street, Kingsway, W.C.2. Price 8s. 6d. net.

The South American Handbook, 1933. Edited by Howell Davies. London: Trade and Travel Publications, Ltd., 14, Leadenhall-street, E.C.3. Price 2s. 6d. net.

Definitions and Formulæ for Students: Metallurgy. By E. R. Taylor. London: Sir Isaac Pitman and Sons, Ltd., Parker-street, Kingsway, W.C.2. Price 6d. net.

The Mechanical Transmission of Power. By the late Professor G. F. Charnock. London: Crosby Lockwood, Ltd., Stationers' Hall-court, E.C.4. Price 8s. 6d. net.

Billige Kessel, billiger Dampf. By E. Practorius. Berlin: Verlag der Verkehrswessenschaftlichen Lehrmittelgesellschaft m.b.H., Vosstrasse 6, W.9. Price 3·50 marks.

Railway and Road Matters.

AMONG the trains which have been speeded-up on the L.M.S. Railway is the 7.45 p.m. express freight from London (Camden) to Liverpool (Edge Hill), which, by making the journey of 191 miles without a stop, holds the "Marathon" record for the longest non-stop journey of any British freight train.

THE death, on January 17th, at the advanced age of eighty-seven, of Sir Charles J. Owens, removes one who was, in his day, a very capable administrator. He succeeded Sir Charles Scotter as general manager of the London and South-Western Railway in 1898, and retired in 1911. Sir Charles was an excellent witness on railway administration and commercial matters, and was one of those who gave evidence on behalf of the railway companies before the Loreburn Royal Commission of 1913.

THE formation of ice on the conductor rail of electrically operated railways, such as occurred on the Southern Railway on the evening of January 18th, happens only occasionally. The Metropolitan Railway meets those conditions by sending over an affected line an old passenger coach which is fitted with snow and ice gear. The equipment is attached to one of the bogies and consists of two cutters, which are lowered and raised by a screw, and a wire brush. The coach is drawn or propelled by a steam locomotive.

THE directors of the Great Western Railway have appointed Mr. A. S. Quartermaine, assistant chief engineer (permanent way and docks), to succeed the late Mr. E. G. G. Matheson, as assistant chief engineer (works and structures). Mr. Quartermaine had had a distinguished educational career before he joined the Great Western Railway in 1910. He served in various capacities in the engineering department, eventually becoming, in January, 1926, the divisional engineer at Bristol, whence he came to London, to be one of the two assistant chief engineers in January, 1929.

THE charge having been made that there has been little improvement in the train services of the Great Eastern section of the L. and N.E.R. during the last ten years, an official statement has been issued showing that that is not so. The statement concludes by saying that the Great Eastern section lines do not lend themselves to high speeds owing to the numerous gradients and severe curves which have to be negotiated, coupled with the exceptional density of traffic in the London suburban area. In addition, a very heavy programme of widening and station reconstruction on the main Colchester line between London and Shenfield also constitutes a severe handicap to train working.

ON the morning of Monday, January 16th, a collision between a passenger train and an empty carriage train occurred in what the newspapers called Canfield-place tunnel, but which is officially known as Hampstead tunnel, on the London and North-Eastern Railway about 2 miles from Marylebone. The cause of the accident has not been made public, but it is important to know that the line is protected by automatic signalling. Moreover, the scene of the mishap is near to where the collision of August 31st, 1924, occurred on the up line. In the latter case an automatic signal was at "danger" because the section ahead was occupied. Under such conditions the driver, after standing for one minute, is allowed to proceed, but must do so with great caution, and be prepared to stop at any obstruction. The man did not, however, proceed with the caution demanded, and his train ran into a light engine.

THE confused situation created by there being no majority report from the National Wages Board on the question of the railwaymen's pay and the report of the independent chairman being in absolute opposition to the views of the sixteen members of the Board, does not seem to have been provided for in the procedure. What appears to be the only course is for the companies and the men to meet and, recognising that eight members of the Board say that there should be a reduction of 10 per cent., and that the other eight consider that the pay should not be altered, agree to some compromise, say, the acceptance of the chairman's findings. Meanwhile, on January 18th, the statement was made that the finding falls, in the opinion of the companies, far short of the merits of the case which they had presented, but they are prepared to accept it, and they have communicated with the unions accordingly. Mr. Cramp is reported to have said that the men will not agree to any reduction.

THE confused result which has followed the application of the railway companies to the National Wages Board has reopened the road-rail controversy, and, incidentally, revived an interest in the proposal made by Lord Daryngton in *The Times* of December 28th. Before relating what that proposal was, we may recall that two days later there appeared a letter from Colonel Alfred Hacking—who may be accepted as a responsible spokesman for the road users—who said that the previous writer was to be congratulated for presenting a constructive thought upon transport evolution of the future, and that he would commend Lord Daryngton's financial transport structure for study, not as a fantastic dream, but as a practical basis upon which the transport facilities of the Empire might ultimately be developed. The proposal thus supported by Colonel Hacking was that the financial control of roads and railways—"steel roads and cement roads"—which are used in the through transport of the country, should be placed under one authority, *e.g.*, the Railway Rates Tribunal. That body might be charged with the duty of finding finance, not only as at present for the railways, but also for the roads. It would create for the purpose a common purse into which would be paid the licence duties of the motor vehicles, or such a proportion of those duties as represents the user of the main roads (which alone are in competition with the railways), and also a proportion of the receipts of the railway companies such as would represent the toll which would be charged for the passing of the traffic on the railways if they had remained toll highways, less, of course, the cost of maintaining the railways, which should be left in the hands of the companies.

Notes and Memoranda.

THE new Zeppelin being built in Germany, with a capacity of 7,000,000 cubic feet, will probably be finished by the spring of 1934. She will have accommodation for fifty passengers.

BEARINGS for steel mill roll necks made of bakelite reinforced with fabric are being used in America. They have a Brinell hardness of from 30 to 40, and are lubricated with water. The coefficient of friction is not mentioned.

THE machinery at a silica quarry near Ottawa was originally driven electrically by current taken from the local hydro-electric scheme. The cost was 3¼ cents per unit. An oil engine of 90 H.P. and a dynamo were put in and the cost brought down to 1 cent per unit.

ACCORDING to Mr. Blackburn, engineer to the Sunderland and South Shields Water Company, the company supplies on an average one-third of a ton of water daily to every house in its area at a cost of 1¼d. Some of the water is brought a distance of 45 miles from Wearhead.

IN some recent investigations by E. B. Kester and W. D. Pohle, it was found that primary tar first formed by heating coal at low temperature on further exposure to heat breaks down in the following order:—Paraffins and naphthenes, acids, neutral oil, aromatics, olefins and pitch. The olefins, aromatics and pitch appear to be the most resistant to change of type by pyrolysis, although there may be little structural similarity between the representatives of each found in the two tars.

MEASUREMENTS have been made on the linear thermal expansion of three samples of cast lead between room temperature and 300 deg. Cent., and the results have been correlated with data obtained by other investigators between 1740 and 1931 in a Research Paper of the U.S. Department of Commerce. A curve has been derived which shows the linear thermal expansion of lead between −253 deg. and +300 deg. Cent. The summary gives average coefficients of expansion for various temperature ranges between −250 deg. and +300 deg. Cent.

IN recuperator service, says *Heat Treating and Forging*, the low-nickel, high-chromium alloys outclass the high nickel-chromium alloys, giving several times the life, owing chiefly to the greater resistance to sulphurous gases. Tubes operating continuously with a wall temperature of 800 deg. to 900 deg. Cent. for eighteen months have been reported as good as new. Such tubes with their surfaces at a temperature exceeding 1030 deg. Cent. have lasted for months in an atmosphere, containing sulphurous gases, in which an ordinary steel nail disappears entirely in two days.

IN the construction of multi-storied welded buildings, the columns can be reduced from floor to floor says *The South African Engineer and Electrical Review*. Pieces which, in shape, resemble a wedge are cut from the end of the web of the larger section at points where the web joins the flange. To do this an oxy-acetylene or oxy-coal gas flame is used, and at the same time the flanges are heated and hammered into the correct line. The flanges and web are then welded together and form a column with cross section identical with that of the column which it is intended to superimpose.

WHAT is said to be the largest amount of current and power ever interrupted by a circuit breaker was recently opened at the East Pittsburgh plant of the Westinghouse Electric and Manufacturing Company, according to the *Electrical World*. The breaker was tested at 50,000, 70,000, 79,000, 90,500 and 118,000 amperes at 7600 volts. This is from 380,000 kVA to 895,000 kVA, single-phase, or 1,140,000 kVA to 2,885,000 kVA, three-phase equivalent. Recent developments in Delon grid arc-interrupting devices made this possible. Oil, grids and breaker parts are reported to have survived in excellent condition and to be ready for further service.

A POWDER for the production of oxygen by chemical methods is being marketed by Griesogen G.m.b.H. The powder, states the *Chemiker-Zeitung*, is sold, packed in air-tight, well-closed sheet-metal containers, and is stated to be stable indefinitely under these conditions. For use the powder is filled into a horizontal retort and ignited. Oxygen liberation commences immediately, and it is stated that 1 kilo. of Oxygal produces about 300 litres of oxygen. The Griesogen Company has built a transportable oxygen producer, in which the gas can be produced by this new method at a pressure up to 15 atmospheres. This gas producer is provided with two retorts, so that continuous oxygen production is possible.

SOME conclusions reached in a report of the American National Electric Light Association, which covers all cable operations for 1931, are: At least 23 per cent. of all joint failures result from inferior workmanship; about 9 per cent. of all failures and anticipated failures were caused by wear at duct mouths; of the 113 inherent failures due to defective insulation, only 5·3 per cent. took place in cable less than three years old, 25·7 per cent. in cable three to ten years old, and 69 per cent. in cable more than ten years old; only five of the total 222 sheath repairs were necessitated by mechanical damages either during or after installation, and only 13 per cent. of the failures due to manufacturing defects occurred in the first two years.

AT the present stage it would appear, says the Report of the Forest Products Research Board for 1931, published on January 18th last, "that the optimum conditions in timber for the development of *Xestobium* (the death-watch beetle) include a comparatively high moisture content and the presence of fungus attack. Even under such conditions the rate of growth of larvæ is extremely slow. The duration of the life cycle of the insect has been estimated by previous workers at two to three years; the laboratory experiments show that it is more likely to extend to five or six years. The future development," continues the Report, "of accurate and reliable laboratory tests of insecticides for use against wood-boring insects depends, not only on the provision of standard material, but also upon information on the penetration of liquids and gases into timber and upon chemical studies of insecticides suitable for the control of wood-boring insects."

Miscellanea.

AN oil refinery is being put up near New Westminster, British Columbia.

AN American company proposes to put up a typewriter factory in Quebec City.

PLANT to the weight of 100 tons is to be carried by air to the Island Lake mining area in North-Eastern Manitoba.

THE Belgian National Railways are calling for tenders for the electrification of line between Brussels and Antwerp.

DURING the past year only 12,776,273 tons of coal and coke was shipped from the Tyne—the lowest for thirty-six years.

CAPTAIN OSCAR SCHARF has been chosen to command the "Europa," in succession to the late Commodore Johnson.

THE Turkish Government has contracted with an American firm for the construction of a railway from Siva to Erzerum.

A COMPANY drilling for oil in Saskatchewan found a salt field at a depth of 3445ft. It is said to be capable of producing 10 tons a day.

THE Norwegian Government has decided to take over the national broadcasting, which is at present controlled by private companies.

WATER wheels and turbines brought into operation during 1932 resulted in a net addition of 378,923 H.P. to Canada's total, bringing it to 7,045,260 H.P.

A BRADFORD textile manufacturing firm has formed a Canadian subsidiary, and is going to establish a mill at Ontario for the production of worsteds, artificial silk, and cotton textiles.

A GROUP of British and New Zealand concessionnaires have secured the right to dredge for gold over nearly 20 miles of the Molyneux River and some 7½ square miles of the adjacent flats.

THE Dominion Bureau of Statistics at Ottawa reports that the mineral production of Canada last year reached a total value of 182,701,000 dollars, as compared with 228,029,018 dollars in 1931.

THE life and work of James Watt is to be commemorated by a memorial institute, which is to be opened in York House, Great Charles-street, Birmingham. It will provide a meeting hall and library for the various engineering societies.

WHAT is said to be the world's largest cofferdam is being dismantled at West Saint John. It will entail the removal of some 700,000 cubic yards of clay and 4,000,000 lb. of steel piling. The dam had a perimeter of 5890ft. and enclosed some 43 acres.

EXCAVATION has started on the Marin County anchorage of the 35,000,000 dollar Golden Gate bridge project at San Francisco. Two power shovels are clearing the site for the anchorage that will hold the north end of the cables for the 4200ft. suspension span.

THE new French airship "E 9," built for the French Navy by the Zodiac concern, made a successful trial flight on January 10th, says *Flight*. This semi-rigid airship is driven by two 350 H.P. engines, has a capacity of 10,000 cubic metres, and carries eleven passengers.

A COMMITTEE has been formed at Thusis (Grisons) with the object of improving the road over the San Bernardino Pass, connecting the Upper Rhine Valley with the Ticino, so as to keep it open the whole year round. The scheme includes a tunnel under the pass so that the road would not rise higher than 4800ft.

FOLLOWING the peak year of 1929, when the highest number of patent applications—39,898—was lodged, the succeeding years, 1930 and 1931, both showed a drop, it being as much as 3000 in 1931, compared with the previous year. In 1932, however, approximately 1000 more applications for patents were filed as compared with the figure for 1931.

ACCORDING to Jordan and Sons, Ltd., company registration agents, 125 companies, having an aggregate capital of £1,401,669, were registered in the "metals" section; 560 companies with a capital of £2,165,363 were registered as "engineers"; 118 companies having a capital of £2,437,714 were registered in the "mines" section; and 85 companies with a total capital of £339,365 were registered in the group "bricks, cement, &c."

ACCORDING to an official report from Kiel, the new German cruiser "Deutschland," which is propelled by 56,800 B.H.P. twin-screw M.A.N. oil engines, returned to Kiel on Thursday, January 19th, having carried out very successful trials in Kiel Bay. The naval officials and builder's engineers all spoke very highly of the quiet running of the machinery. A large number of people awaited the return of the ship to harbour. It will be recalled that the propelling machinery of the "Deutschland" was fully described and illustrated in our issue of January 15th, 1932.

ORGANISED parties of buyers are coming to the Birmingham Section of the British Industries Fair this year from Belgium, Holland, Germany, Switzerland, Sweden, Norway, Denmark and Portugal. Reduced rate tickets are being issued by the majority of the passenger steamship services on the Scandinavian and Northern European routes to England, the leading European airway companies and the railway systems of Austria, Belgium, Bulgaria, Czecho-Slovakia, Germany, Greece, Hungary, Latvia, Lithuania, Poland, Portugal, Roumania, Switzerland and Turkey, as well as of Great Britain.

ACCORDING to the *Electrical World*, the 200,000 H.P. project on the Fusenko River, Korea, has recently been completed. The Fusenko has been dammed to provide a storage of 25,000,000,000 cubic feet. A pressure tunnel 17 miles long leads the water to a surge chamber on the far side of a mountain range. From the surge chamber a pressure pipe leads to the power station. The plant comprises four Pelton horizontal single-wheel turbines with two nozzles, directly coupled to the generators, and operating under a head of 2180ft. Official tests showed a maximum efficiency of nearly 92 per cent.

BURRARD BRIDGE, VANCOUVER

(*For description see page 84.*)

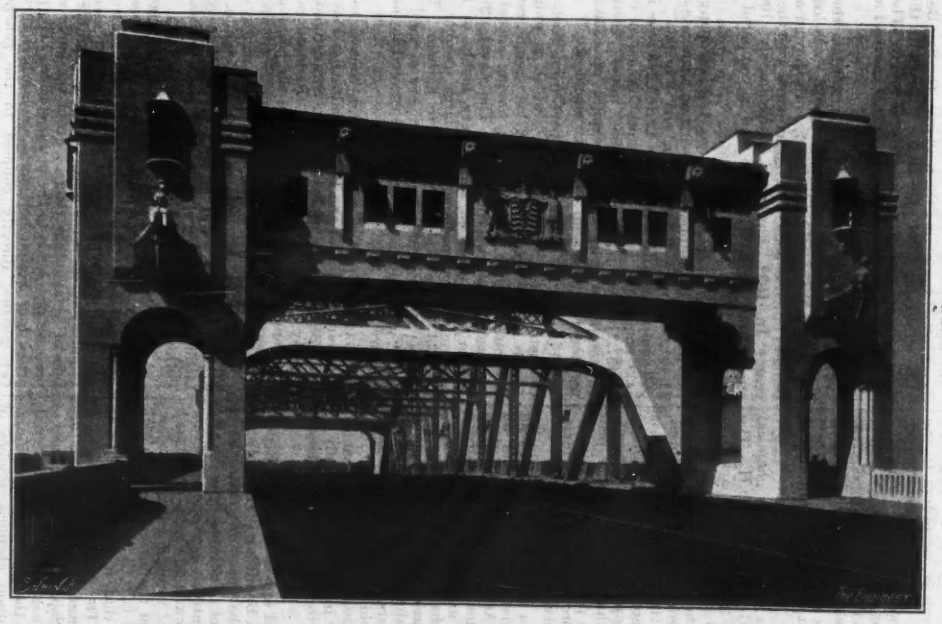


Fig. 4—The reinforced concrete pylons and cross gallery at the end of the through truss channel span.

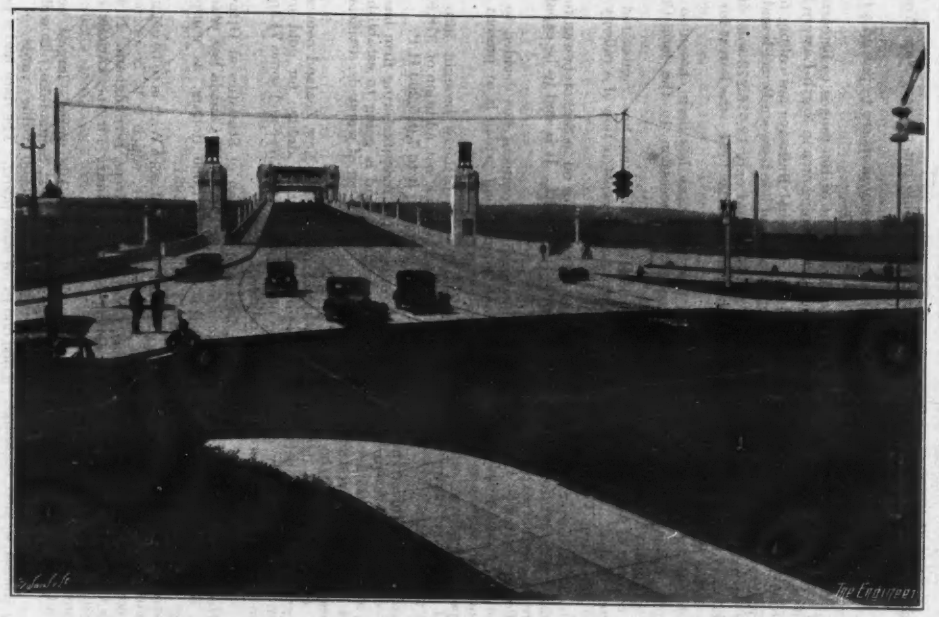


Fig. 5—The north approach to the bridge showing the traffic control arrangements at the intersection of Burrard and Pacific Streets.

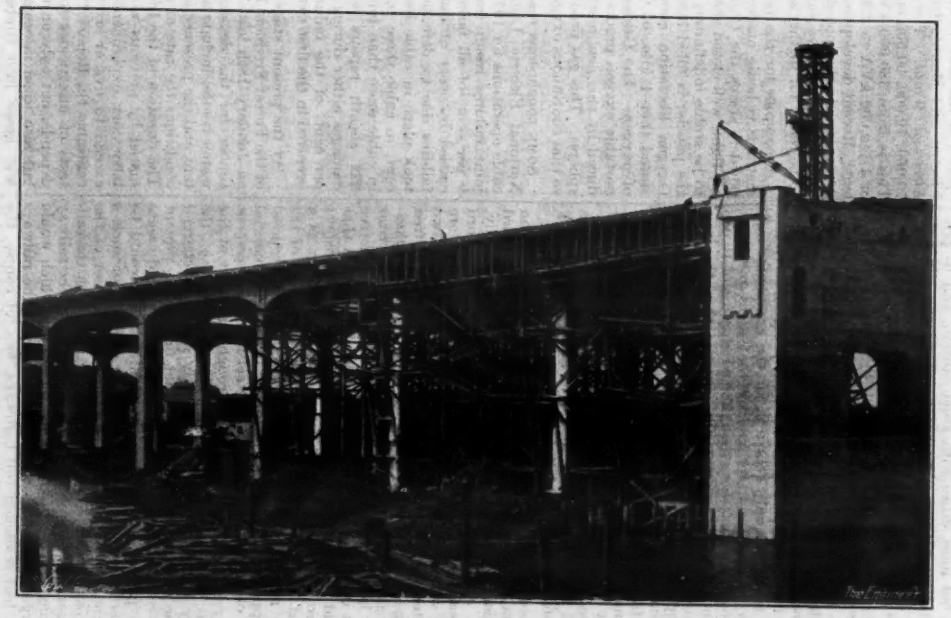


Fig. 6—The reinforced concrete viaduct at the south end of the bridge and pier No. 1 of the steel truss portion.

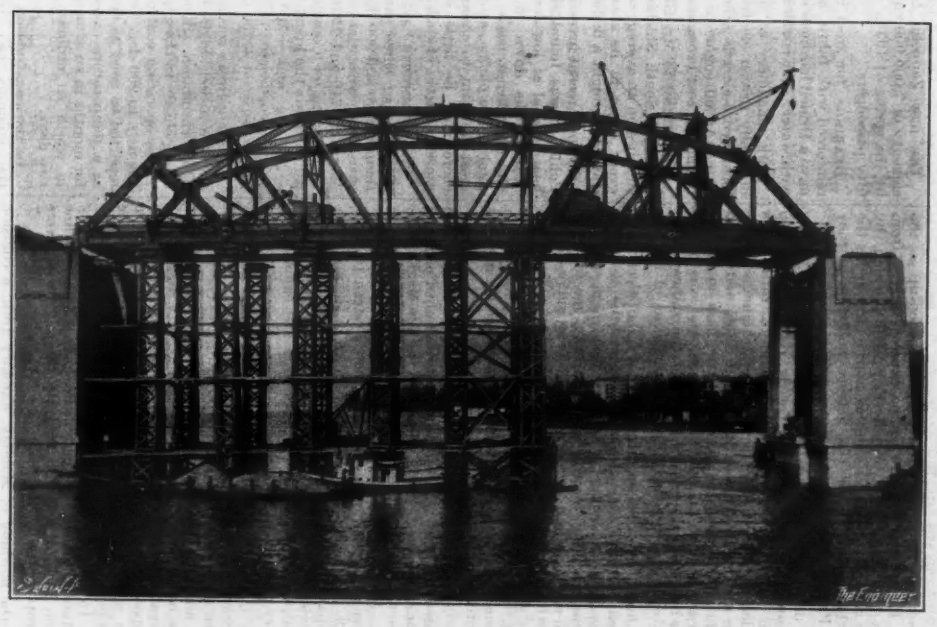


Fig. 7—Erecting the through truss span on falsework with the four end panels cantilevered over the navigable channel.

The Engineer

JANUARY 27, 1933.

VOL. CLV. No. 4020

Contents.

THE ENGINEER, January 27th, 1933. PAGE

A SEVEN-DAY JOURNAL .. 83
BURRARD BRIDGE, VANCOUVER. (Illus.) .. 84
THE INTERNATIONAL RAILWAY CONGRESS. No. II. .. 85
RADIUM IN CANADA .. 87
THE WORKS OF TUBE PRODUCTS, LTD. (Illus.) .. 89
THE PHYSICAL SOCIETY'S EXHIBITION. No. III. (Illus.) .. 90
LITERATURE .. 92
SHORT NOTICES .. 92
BOOKS RECEIVED .. 92
RAILWAY AND ROAD MATTERS .. 93
NOTES AND MEMORANDA .. 93
MISCELLANEA .. 93
LEADING ARTICLES—
The Electric Wiring of Ships .. 95
Unemployment and the Forty-hour Week .. 95
OBITUARY—
Thomas Charles Pulman .. 96
LETTERS TO THE EDITOR—
Oil-electric Locomotives—Steel Railway Coaches .. 96
ARTHUR WOOLF, 1766-1837 .. 97
SIXTY YEARS AGO .. 97
THE INTERNATIONAL ALUMINIUM COMPETITION .. 97
THREE-CYLINDER COMPOUND LOCOMOTIVE—GREAT NORTHERN RAILWAY (IRELAND). (Illus.) .. 98
GLASS BULB RECTIFIERS. (Illus.) .. 99
THE LEYLAND OIL ENGINE. (Illus.) .. 100
2500-GALLON PETROL TANK. (Illus.) .. 100
HORIZONTAL PORTABLE BELT CONVEYOR. (Illus.) .. 100
A CABLE-MAKING FILM .. 100
CANADIAN ENGINEERING NEWS .. 101
PROVINCIAL LETTERS—
The Midlands and Staffordshire .. 101
Lancashire .. 101
Sheffield .. 102
North of England .. 102
Scotland .. 103
Wales and Adjoining Counties .. 103
CALENDARS, DIARIES, &c. .. 103
CATALOGUES .. 103
CURRENT PRICES FOR METALS AND FUELS .. 104
FRENCH ENGINEERING NOTES .. 105
BRITISH PATENT SPECIFICATIONS. (Illus.) .. 105
FORTHCOMING ENGAGEMENTS .. 106

INDEX TO VOLUME CLIV.

TWO-PAGE SUPPLEMENT—GREAT NORTHERN RAILWAY (IRELAND)—THREE-CYLINDER COMPOUND EXPRESS LOCOMOTIVE.

NOTICES TO READERS.

**** If any Subscriber abroad should receive* THE ENGINEER *in an imperfect or mutilated condition, he will oblige by giving prompt information of the fact to the Publisher, with the name of the Agent through whom the paper is obtained. Such inconvenience, if suffered, can be remedied by obtaining the paper direct from this office.*

**** For Subscription rates, see page 2 of Advertisements.*

**** All letters intended for insertion in* THE ENGINEER *or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

**** No undertaking can be given to return drawings or manuscripts; correspondents are therefore requested to keep copies.*

THE ELECTRIC WIRING OF SHIPS.

IMPORTANT as it is that the work of wiring ships should be properly carried out in order to secure reliability and to avoid all possibilities of fire, the amount of attention that has been paid to the subject by electrical writers appears to be small as compared with that devoted to the wiring of buildings. Even the recent fires on ships have led few practical men, in a position to judge, to express their views on the possible causes in the technical Press. In one case, at least, it has apparently been pretty definitely proved that electricity was at the root of the trouble, as it has been in a fair number of fires on land, but although we have heard it said that the wiring of ships is not always of the most desirable kind, opinions in the form of letters to technical editors have been remarkably scarce. The matter is one which should surely claim the attention of the Institution of Electrical Engineers, especially in view of the tightening-up of the French rules governing the use of electricity in ships. Fires at sea are so serious and so appalling that no body interested in the welfare of electrical progress, such as that Institution, should assume that everything has been done to avoid them without first reviewing the whole position. In fact, recent statements seem to indicate that if ships' wiring formed the subject of a discussion at the present time interesting and important suggestions would be put forward regarding increased reliability and safety.

Rules are, of course, issued by the Institution of Electrical Engineers and Lloyd's Register of Shipping. Impressed by the necessity for uniformity of practice and the use of standard apparatus, a "Ship Electrical Equipment" Committee composed of members of the Institution of Electrical Engineers and others interested in the matter was set up in May, 1916, and regulations based on its findings were published in 1919. Seven years later the rules were revised, notably as regards allowing higher pressures for large motors, and greater latitude in the current carrying capacity of cables under special conditions of loading. These were issued as recently as 1926, and the existing rules of Lloyd's Register a year later, yet some may be tempted to ask whether, in view of the experience that has since been obtained, they ought not to be revised again. Although the new French Regulations are said to stipulate that certain parts of ships hitherto made of wood must henceforth be composed of metal, and that the sheathing of all wires and cables must be visible, the Institution of Electrical Engineers' Regulations explain that if not exposed to mechanical damage and if placed in dry situations, cables of all the classes specified may be run in wood casing which, provided that ready access may be had to the cables, may form part of the ornamental woodwork. As far as can be gathered from the relatively small amount of published information on the wiring of ships, the type of cable most suitable for the purpose seems to be one of the most vexed questions. When Mr. W. McClelland read a paper on "The Applications of Electricity in Warships" before the Institution of Electrical Engineers in 1927—the most recent paper read before that body having any relation to the subject under consideration—Mr. J. E. Allan explained in the course of the discussion that experience in the merchant service with vulcanised rubber lead-covered cables operating on the earth return system had shown that these cables had a short life, especially in the case of vessels trading in hot climates. Instead of the system working with one pole earthed it was not uncommon for both poles to become earthed, until ultimately the wiring had to be renewed. The reasons given for the trouble were: deterioration of the rubber owing to its unstable nature, chemical action reducing the sheathing to salts of lead, cracking of the lead caused by vibration, and pitting and corrosion of the sheathing by electrolytic action brought about by salt-laden moisture lodging between the cables and the steel structures to which they were secured. Mr. Allan also explained that a new difficulty, which even the Ship Electrical Equipment Committee did not seem to have anticipated was the rapid deterioration of the ends of the rubber insulation of cables in use in oil-engined ships or in situations where oil and oil vapours had access to the cables. Experiments that were being carried out at the time with a view to overcoming the latter trouble were leading to promising results, but apparently cables used under ordinary conditions in ships are still liable to cause fires. Writing in the *Electrical Review* of January 13th, Mr. M. S. Bagnall, a late electrical engineer officer of one of the largest mercantile marine shipping companies, states that during the numerous voyages he made every fire of an electrical origin was due to lead-covered cable. At very little extra cost, Mr. Bagnall contends, the entire installation could be carried out with one of the many fireproof unbreakable cables at present on the market. Where armoured and asbestos-braided V.I.R. cables were installed in the engine and boiler-rooms and tunnels failures are said to have been practically nil, even when the coverings were continually saturated with water and oil in a high ambient temperature. The absence of trouble with this type of cable is attributed to its capability of withstanding the movement and "working" of the ship's structure throughout any length of the cable run, but owing to size it is realised that it could not be used in passengers' quarters. For these parts of the ship flexible cab tire asbestos-braided rubber insulated cables are recommended, instead of the usual V.I.R. lead-covered cables, which have been found to give trouble. A subsequent letter appearing in the same journal above the signature Harry W. Beara, another sea-going engineer, entirely supports these contentions and explains that although all circuits have repeatedly been found to be in good working order before the ship leaves her berth, trouble with the wiring begins as soon as she puts to sea. A period in dry dock or a spell of bad weather has been found to have the same effect in a minor degree, thus proving in the opinion of Mr. Beara, that the "working" of the ship's structure causes cable failures.

By reason of the extensive use of lead-covered cables on ships, it would be interesting to know how many more marine engineers share these views or have other suggestions to make regarding the prevention of electrical fires. The subject of ships' wiring is one which affords good scope for discussion, and it would be an excellent thing if the Institution of Electrical Engineers could arrange for something of this nature in the near future. The subjects dealt with at the London meetings of this Institution do not vary greatly from year to year. There is perhaps a paper on electrical communication, another on electric traction, and possibly a third on electricity on the farm or the electric heating or lighting of buildings, which, together with a few contributions dealing with highly specialised subjects which few save the authors really understand, are apt to prove a little wearying to those who make a regular habit of attending these meetings. But a paper or even a short talk on the wiring or electrical equipment of ships would break away from the well-covered ground and afford practical men an opportunity of discussing a matter that certainly demands attention at the present time.

Unemployment and the Forty Hour Week.

THE workers' resolution at the Geneva Conference that the same pay should be given for a shortened week met with its anticipated reception. For what it is worth an adverse vote of 32 votes to 21 was recorded. But with several industrial nations, the United Kingdom included, abstaining from the poll, even a favourable majority would have meant little, or nothing. The plain fact is that international agreement upon hours of work and rates of pay will never be reached, or, if it be reached, will never be effective. The conditions of no two nations are precisely the same. France, with an industrial population too small for her needs, is not to be bound by regulations which might suit Germany and England, with their excess of workers. Moreover, in some countries, long hours of toil are not held, even by the toilers themselves, to be objectionable. The workers modify their exertions to suit the hours and refuse to be hurried. They would rather work ten or twelve hours a day than be harassed by feed-and-speed men. There is no reason why such nations should not "gang their ain gait." It is not the hours they work that matter, but the amount of stuff they turn out in them, and, most of all, the price of the product. Vain is the hope that those can be settled by an international agreement on the length of the working day. They are mixed up with a dozen other things over which international control is quite unthinkable. Even a universal agreement on a forty-hour week would not prevent competition on prices. It is not by international, not even by national, but probably by local agreements that a solution of the problem is to be found. The shorter week may be practicable in some industries, and not in others.

The shortened week is advanced as a method of decreasing unemployment. We have grave doubts that it would have any such effect for any length of time. The ability of the engineer to devise means for reducing the necessity of human hands in manufacture is not exhausted. It can be carried much further, and will be so carried, if it becomes economical to do so. An increase of the hourly rate for labour would be a predisposing cause. At the present time, the labour cost of producing a motor car is 15 per cent. of the total cost. Manufacturers are very unlikely to allow it to rise above that figure. If shorter hours are worked more machinery, not more men, will be employed. The logical way to increase employment is to reduce wages. Then it would pay employers to use men rather than machines. America became the greatest originator of automatic machinery, because labour was scarce and dear. In Great Britain, even at this day, automatic machinery is not the necessity that it is in the United States, because wage rates here are lower. The reason why Detroit could pay high wages in the years of American prosperity was the relatively small amount of labour per unit of output. When labour is a large item in the total cost, pay must be low, or the price will be great. These are all familiar facts which would be obvious were they not obscured by considerations which hide, but do not remove, them. They lead inevitably to the conclusion that an increase in the hourly rate of wages, *i.e.*, the shorter week for the present pay, would mean the introduction of more labour-saving machinery so that, *for the same output*, the number of hands would be less instead of greater. A reduction of output per man by shortening the week, could not, therefore, fail to increase unemployment. It would force the employers to use more machinery. If consumption of products increased, all might be well even then, for augmentation of production is the only road to augmentation of employment. The history of the factory makes that quite clear. Mechanisation improved the lot of the workers. It gave them higher wages, shorter hours, and more constant employment. The further increase of mechanisation will have the same effect—as long as an expanding market can be found. That is the crux of the problem. The bottom has fallen out of the markets of the world. When buying begins again there will be plenty of work. All the unsatis-

ried needs of the past lean months will have to be made good. We shall not hear of the forty-hour week as a cure for unemployment; but we shall hear of it as a natural corollary to increased mechanisation.

The reduction of the working week began years ago, and has gone on consistently ever since. One may well ask what is the value of labour-saving machinery if man has to labour as long as before? It has already reduced the working week from seventy to forty-seven hours. It can reduce it still further, and will have to do so. Even the economic problem is not insoluble. More mechanisation means less labour. Less labour means that higher rates per hour can be paid, as in the motor industry. Higher rates per hour is the same thing as shorter hours for the same pay. The real difficulty resides in those industries, the heavy industries, which are least subject to mechanisation; the possibilities there have not been exhausted, but any national agreement that tried to include them would meet with inevitable and strong opposition. Let us, moreover, be quite clear on one point—nothing can be done whilst consumption remains low. No one can mechanise for a small output; the plant is too costly. Yet, without further mechanisation shorter hours for the same pay must increase the proportion of labour costs to total costs, and jeopardise the power of competition in markets abroad. Oddly enough, we are led logically to the paradox that to increase employment we must decrease the need for labour.

Obituary.

THOMAS CHARLES PULMAN.

THE death of Mr. Thomas C. Pulman, director of Worthington-Simpson, Ltd., of London, which was briefly recorded in our last issue, will be regretted by a wide circle of engineers, not only in this country, but also in India and America. It will be recalled that, owing to a serious illness, which unhappily greatly limited his activities, Mr. Pulman, although still continuing his directorship, retired from the position of managing director of Worthington-Simpson, Ltd., in July, 1930, an office which he had then held with distinction for more than thirteen years.

Thomas Pulman was born in London in 1866 and received his education at Folkestone College, afterwards attending courses in engineering at the Polytechnic, London. In 1882 he was indentured to James Simpson and Co., of Westminster, and after completing his full term of five years' apprenticeship he was appointed resident and supervising engineer of foreign contracts. In the years between 1887 and 1892 he represented his firm on important contracts in Holland and Gibraltar and in South America and Russia. His appointment as manager of the company's business in India and the East was made in 1892, and he ably filled it for eighteen years. During that time Mr. Pulman was principally engaged in the construction of water, sewage, and irrigation works for the Public Works and Irrigation Departments of the Government of India, as well as similar undertakings for the municipalities and Native States, which included installations at Bombay, Calcutta, Delhi, Madras, Simla, Lucknow, and other large towns in India and Burma.

On his return to England in 1910 Mr. Pulman was appointed a member of the managing committee of James Simpson and Co., and also became manager of the associated firm of the Worthington Pump Company, Ltd. In 1912 he was elected to the board of the Worthington Company, and two years later he became a director of James Simpson and Co., Ltd. He continued his directorship of both companies until their amalgamation in 1917, when the company of Worthington-Simpson was formed, and he was again elected to the board and shortly after made managing director, a position which he continued to hold until his retirement a little over two and a-half years ago.

Thomas Pulman had a wide and varied experience of engineering, both on the technical and sales sides, and was acquainted with American and Continental developments. He assisted in designing and building up a fine engineering works at Newark-on-Trent, of which he was justly proud. He was a member of the Executive and Grand Councils of the Federation of British Industries, a Vice-president of the British Engineers' Association, a member of Council of the British Electrical and Allied Manufacturers' Association, and a member of Council of the Electrical Research Association. He was a member of the Institution of Civil Engineers, the Institution of Mechanical Engineers, the Institute of Marine Engineers, and the American Society of Mechanical Engineers. With a genial and delightful personality, he was known affectionately by an exceptionally wide circle of engineers, all of whom heard with deep regret of the sudden illness which incapacitated him for further work.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents).

OIL-ELECTRIC LOCOMOTIVES.

SIR,—Colonel Fell is certainly to be congratulated on his paper, and you, Sir, upon your Leader in THE ENGINEER of January 20th. The silence of railwaymen during a discussion of this kind is to be deplored. Possibly the railway companies do not encourage the voicing of opinions.

Dealing with the title of Colonel Fell's paper, one is tempted to remark that it is questionable whether British railways should use oil engines at all until suitable supplies of fuel produced from coal are available. Not only does the national economic point of view deserve consideration, but, in addition, the collieries are surely the railway companies' best customers, and deserve attention. It would appear that the gas-engined locomotive deserves more consideration meantime.

However, assuming that these objections can be answered in a satisfactory manner, the next point to consider is Colonel Fell's apportionment of the cost of oil-electric locomotive construction. I am inclined to agree with Colonel Fell's costs of engine and chassis as being feasible. I am also inclined to accept his figure of £8 per B.H.P. as what the electrical manufacturer will demand for his share. It is somewhat astonishing, however, that so far nobody has criticised this figure, which exceeds the cost of the engine and chassis added together. Can anyone say why it cannot be brought down to the level of, at any rate, the chassis price? Analysis of the materials used in the construction of the electrical gear in the chassis fails to disclose gold or platinum or other rare metals. There is, however, an element—B.E.A.M.A.—which probably has a considerable bearing on the case.

At the figure given by Colonel Fell there is little future for the oil-electric locomotive in England, but I am sorry that Colonel Fell in his paper concentrated on electric transmission in view of the ghastly cost of the electric end. I can assure him that he is incorrect in his statement that alternative forms of transmission will fail owing to savings being offset by the higher cost of the engine. I personally believe that given decent runs of standard engines, his figure of £2 10s. per B.H.P. can be obtained with medium speed engines.

Speaking with some knowledge of steam locomotive construction and considerable admiration of the manufacturing abilities of certain British steam locomotive builders, I would say that there is no prime mover made where the customers get better value per ton or per B.H.P. than when purchasing a high-class steam locomotive; and I think that if the locomotive builder was not forced to fit proprietary sand-boxes, regulators, &c.—all of which have to carry full manufacturing costs, profits, and expensive selling organisations—the cost would be lower still.

The engine may be a good one, but, after all, it is only one way of making an engine, and there seems no reason why several other types cannot meet Colonel Fell's specification.

Taking Colonel Fell's point that "mineral and shunting traffic" offers the greatest scope for oil locomotives, with which I unhesitatingly agree, the medium-speed oil engine seems to be indicated as, there being no passengers, the heavy torque recoil will not worry them, while remote control not being required this feature of electric transmission serves no useful purpose. Pontifical utterances are likely to be hurled at my head, but at the risk of this happening, I would question the virtues of the high-speed heavy oil engine, except where used for electric transmission.

I have a great fondness for the C.I. engine, but the slower the speed, the more I like it, because the slower it runs the more it approximates to the steam engine, as far as "hanging on" is concerned.

I am inclined to accept 750 r.p.m. as a satisfactory speed to preserve these characteristics.

I am next going to suggest that during the last few years the greatest single contribution to the problem of cost reduction on the British railways, as far as locomotive power is concerned, has been the Sentinel shunting locomotive. I admit that its use is limited, but it effects very considerable savings, and demonstrates the load starting power of a geared engine fitted with a compact power unit.

I now suggest in all humility that Colonel Kitson Clark's efforts in oil-steam locomotive construction have demonstrated the extraordinary load starting powers of the combined system and also the possibility of bringing a large-sized slow-running C.I. engine within the limits of the English loading gauge. I now suggest the combining of the Sentinel boiler and engine burning oil with an oil engine of the good pulling type, the Sentinel being used to start and accelerate the train up to the point where, aided by a hydraulic clutch the oil engine will come in, a lap period being provided for, after which the Sentinel engine declutches and shuts down.

The short periods for which steam is used mean that the effect of the oil used for steam raising will not affect the fuel bill materially, a heavy increase in tractive effort will be obtained at starting, and the transmission cost will be such as to bring the total locomotive price within the figure which will interest the railway companies.

I feel sure that this suggestion will bring forth the usual crop of objections regarding the use of a boiler, and the statement that if a boiler is used at all you might as well have a steam locomotive.

If the oil locomotive is going to be used its cost must approximate to that of a steam locomotive, its simplicity must be reasonable, and its characteristics at work must approximate to those of the steam engine. I submit that it is feasible in the line indicated.

In conclusion, a statement from the railway companies as to the utilisation of imported fuel would clear the air, and save a lot of time, thought, and money being wasted. If they cannot use oil for the reason given in my letter, let them say so. If they can, then I suggest that they draw up a specification giving the weight, dimensions, and power of a mineral locomotive that would interest them, stating the price at which it interests them, and invite competitive designs, with a view to running another Rainhill trial.

K. W. WILLANS.

Ashton-under-Lyne, January 21st.

SIR,—In the short report of my remarks on Lieut.-Colonel Fell's paper before the Institution of Mechanical Engineers, published in your last issue on page 73, a statement is made that my firm—Armstrong, Whitworth and Co., Ltd.—"was not endeavouring to produce a very light engine." Actually, no such words were used by me, though such a deduction might conceivably have been made, and, as reported, this statement may give a quite wrong impression of our views.

We appreciate fully that the ideal engine is the lightest and smallest that can be produced which meets the requirements of railway traction, and at the same time gives the necessary degree of reliability. That ideal is always before us, but we prefer to approach it by gradual stages from the starting point of the relatively heavy type which has already been used with satisfactory results for this particular duty.

A. ORTON.

London, S.W.1, January 23rd.

SIR,—In your editorial of January 20th you extend a welcome to an authoritative statement concerning the price of oil-electric locomotives.

Several recent tenders have been submitted by Sir W. G. Armstrong, Whitworth and Co. (Engineers), Ltd., for main line locomotives to be built in quantities approaching those in which steam locomotives are normally manufactured, and the price in these cases is not more than £13 10s. per B.H.P.

These locomotives employ the medium-speed Armstrong-Saurer railway type of engine, and not the high-speed types which this firm also manufactures for use on light rail cars and small locomotives.

Close estimates show that a very definite point exists at which employment of the single medium-speed engine is more economical than several small high-speed engines, and this point is well below that required for goods or mixed traffic haulage.

We would regard the employment of an engine which could be built for £2 10s. per B.H.P. as a mistake of the first magnitude. The oil engines for use on railways must be of the sturdy, long-lived type.

P. D. IONIDES, Vice-Chairman,
Sir W. G. Armstrong, Whitworth and Co.,
London, January 24th. (Engineers), Ltd.

STEEL RAILWAY COACHES.

SIR,—With reference to the letter appearing in your last issue, signed "F. N. B.," it is perhaps not out of place to mention that a report by Mr. H. N. Gresley, chief mechanical engineer of the London and North-Eastern Railway, on this very subject, and entitled "All-metal Rolling Stock: Carriages and Wagons. Use of Light Metals and Alloys. Use of Autogenous Welding," is being discussed this week at the Cairo meeting of the International Railway Congress Association.

Your correspondent, if he refers to that paper, will find it clearly stated that under British conditions "All-metal carriages are found to be more costly to construct and are heavier than carriages of which the bodies are made of wood."

It may be pointed out that there are many railways outside this country still standardising on wooden body construction, and equally it should be remembered that the weight per seat with metal or wooden bodies only becomes equal with coaching stock of greater length than is normally in use on the British railways.

With the universal employment of electric lighting for all modern rolling stock fire risks have been greatly minimised, whilst the improvement in couplings has reduced considerably the risk of telescoping; there are many who would maintain that the task of extracting injured persons from all-metal rolling stock largely offsets any possible reduction of the danger from telescoping.

The question of first cost is, in these days, an important consideration, and if your correspondent looks through the published cost figures of recent all-metal passenger rolling stock put into service on certain Continental European railways he will find that the costs vary from 50 per cent. to 200 per cent. above similar coaches put into service on British railways.

C. E. R. SHERRINGTON.

Belmont, January 24th.

Arthur Woolf, 1766—1837.*

By RHYS JENKINS.

THIS year 1933 marks the centenary of the death of Richard Trevithick. It happens also that it is a hundred years since another Cornish engineer, Arthur Woolf, gave up work, to die in retirement a few years later. Woolf's name is known in connection with the compound engine and with the Cornish pumping engine, but he never attained the celebrity of Trevithick, his contemporary—one cannot say rival, for, except for a few years, their paths in life fell far apart—nevertheless, his life and work call for recognition. He was born at Camborne in 1766. Of his early days in Cornwall we know nothing beyond that he served an apprenticeship to a carpenter and joiner at Pool, between Camborne and Redruth. Shortly after the end of his apprenticeship he made his way to London and found work as a millwright; then he was taken on at Bramah's works, where he had Henry Maudslay as a fellow-workman. He and Maudslay seem to have left Bramah at about the same date; at any rate, we find him in 1796 in County Durham, at Newbottle and Charters Haugh coal mines, erecting winding engines for Hornblower and Maberley.† The work upon these engines was stopped by the intervention of Boulton and Watt as infringing Watt's patent. Upon his return to London, Woolf was employed in erecting an engine for the same firm—Hornblower and Maberley—at Meux's brewery, and at the brewery he remained from April, 1797, to October, 1806, when he entered upon engine making in London with Humphrey Edwards as partner. The partnership lasted until 1811. In that year Woolf returned to Cornwall, and in that county he worked for over twenty years. When he retired in 1833 he went to live in the Island of Guernsey, and there he died in 1837.

Whilst at Meux's brewery he added a cylinder to—*i.e.*, compounded—a small engine, made by Fenton, Murray and Wood, already at the brewery, and then proceeded to build an entirely new compound engine. It was intended to be of 30 horse-power, and he gave it cylinders 30in. and 8in. diameter, the piston strokes being 5ft. and 3ft. respectively. The boiler pressure was 40 lb. As may be expected, the engine would not do the work required of it, the boiler and the high-pressure cylinder were too small.

Woolf having spent more than two years upon the trials and alterations of these engines at the brewery, his employers became dissatisfied and consulted Rennie, whose opinion was altogether against Woolf's ideas. The brewers decided to abandon the compound engine, and ordered a 30 horse-power engine from Boulton, Watt and Co. Possibly they were rather hasty in taking this step, for it was alleged by the partisans of Woolf that the new engine had to run twenty hours a day to do the same work as Woolf's engine had done in seventeen, and that it consumed double the quantity of coal.

However, this setback led to Woolf's throwing up his appointment and soon after he entered into partnership with Humphrey Edwards in an engine works in Mill-street, Lambeth, and by the year 1811 he had, says Farey, brought his designs for rotative compound engines to a standard form. In general appearance the engines were like those of Boulton and Watt. At first the two cylinders were placed side by side with the two piston-rods attached to the same pin of the parallel motion, but later Woolf went back to the arrangement with the small cylinder nearer to the centre of the beam than the large cylinder. The two cylinders were enclosed in one steam case which was in open communication with the boiler. The boiler was of cast iron with two tubes lying side by side above the fire-grate, and a superposed barrel lying parallel to them. The cylinder volumes were now in the ratio of 5 to 1.

In 1811 Woolf applied a small engine to drive a flour mill with two pairs of stones, and arranged for a competitive trial between it and one of Boulton and Watt's engines at Battersea. The result, to put it briefly, was that the Boulton and Watt engine ground 5·91 bushels of wheat for each bushel of coal consumed, while the Woolf did 17·25 bushels. Farey, however, points out that the Boulton and Watt engine was an old one, and probably not in the best condition. He thought that the consumption of a Boulton and Watt engine should not be more than double that of the Woolf engine. This particular Woolf engine was taken to Cornwall. Farey saw it at Wheal Vor in 1818. No drawing of a Woolf engine has been found of a date earlier than the dissolution of the partnership with Edwards. The drawings show two cylinders mounted in the same steam case, and placed side by side. The beam, the connecting-rod, the crank, and the shaft are of cast iron and the plummer blocks of the beam gudgeons are carried by four splayed cast iron pillars. The pistons have metallic packing. The boiler is formed of two cast iron tubes lying over the fire grate, and one cast iron barrel placed above and parallel to them. From the boiler the steam passes to the steam case from which the high-pressure cylinder is supplied through a throttle valve controlled by a governor. Both the throttle valve and the valve for the high-pressure cylinder are in the form of cocks, the latter has two passages, one for admission, the other for exhaust, and is worked by a three-sided cam on a rotating shaft. The exhaust from one end of the high-pressure cylinder passes directly to the opposite end of the low-pressure cylinder, the exhaust parts of which are opened and closed by two disc valves placed concentrically one above the other. The spindle of the lower valve passes concentrically through the hollow spindle of the upper valve, and both spindles pass through arms fixed on a vertical actuating rod, which is worked by the cam. Upward movement of the rod opens the upper valve and closes the lower, and *vice versâ*.

The Woolf engine is one in which the two pistons are at the ends of their strokes at the same time, *i.e.*, the angle between the cranks is 0 deg. or 180 deg. The form of engine with the cranks at some other angle, the intermediate-receiver engine, was patented in England in 1834, and by a man named Wolf. The similarity of the names has given rise to some confusion in the past, but the researches of Monsieur Mallet and others have made it clear that the inventor was G. M. Roentgen, of Rotterdam, and that Wolf was merely his agent in London.

Woolf returned to Cornwall in 1811, and it may be that by this time he had had instructions to put a compound pumping engine at Wheal Abraham, as well as that at Wheal Vor, for Trevithick, writing of the Wheal Vor engine in 1815 said that it had taken two years to erect. The Wheal Abraham engine was at work in the autumn of 1814. Wheal Vor engine was started soon after. These engines were single-acting. The Wheal Abraham engine had cylinders 45in. and 24in. diameter, with piston strokes of 7ft. and 4·3ft. respectively. The corresponding figures for the Wheal Vor engine were 53in., 28in. 9ft. and 6ft. The relative volumes of the cylinders were 5·3 to 1 for Wheal Abraham, and 5·75 to 1 for Wheal Vor engine. The expansion was 8·5 or 9 times and the boiler pressure was 40 lb. The boilers were made up of seven tubes and a barrel, 4·5ft. diameter and 15ft. long, lying transversely above them.

At first these engines did extremely well; in 1815 the average performance for the year of thirty-three Boulton and Watt engines was 19·75 millions—*i.e.*, foot-pounds of water per bushel of fuel. The average for the Wheal Abraham engine for the last six months of the same year was 48·63 millions, while in its best month it showed 52·33 millions. The corresponding figures for Wheal Vor engine were 47·63 and 50·45. These results led to the setting up of other engines. At Wheal Abraham a larger engine with a 60in. low-pressure cylinder was erected in 1816, and in the same year a 60in. engine at Wheal Unity (Tadpole) was compounded by the addition of a 34in. cylinder. This engine had the beam below the cylinder. At Crinnis an engine with a 53in. low-pressure cylinder was at work in 1819. Then in 1824 we have the sixth and last of the Woolf compound pumping engines, that at Wheal Alfred. By this time the single-cylinder engine had come to the front and there were some of them that showed very high results; moreover, it was found that in continued working the compound engine failed to maintain its original efficiency, and it had become a question whether there was any advantage in the use of two cylinders. Accordingly, when in 1824 working was resumed at Wheal Alfred, under the management of John Taylor, Woolf was instructed to set up two engines—one a compound single-acting engine with Woolf boilers, and the other a single-cylinder engine with Cornish boilers. The compound engine had cylinders 70in. and 40in. diameter, the stroke being 10ft. and 6·5ft. respectively, the large piston was hemp-packed, the small one had metallic packing; the small cylinder had no steam jacket, the large one had an outer casing, but it was not supplied with steam because the position of the boiler was such as not to allow the condensation to run back. The other engine had a 90in. cylinder and was of 10ft. stroke. The engines commenced working in the autumn of 1824, and the single-cylinder engine was found to give the best results. Its average performance for the year 1825 was 42 millions, as against 40 for the compound. Farey attributes this, in part, to the superiority of the Cornish boiler, and, in part, to the fact that the single-cylinder engine was more favourably loaded than the compound.

When, a few years later, the mine was given up, the single-cylinder engine was moved to the Consolidated Mines and fitted with a steam jacket and non-conducting clothing. It then became known as Woolf's engine and attained a duty of over 60 millions. The compound engine was dismantled, and its cylinders were used for separate engines. It was the last compound engine made by Woolf, and now there was not one of his engines working compound in Cornwall.

But although his own particular forms of engine and boiler were rejected in Cornwall, Woolf, in spite of a notoriously bad temper, rapidly came to the front as an engineer, and it is agreed on all hands that his influence on the perfecting of the Cornish engine and on the development of engine building in Cornwall was of the first importance.

Hocking, who had worked under him from 1828 to 1833, states that Woolf had thought of setting up an engine works himself, but was induced by Harvey, of the Hayle Foundry, to assist in the enlargement of the Hayle works, and that he was the superintendent of that establishment up to the time of his retirement in 1833. Possibly the connection may have commenced about the year 1820. At first, it can only have been of an advisory nature, or a part-time arrangement, for at that period Woolf was extensively engaged in the supervision of mine engines in all parts of Cornwall.

Then as time went on, not only were more engines built, but more and more of the work thereon would be done at the engine works instead of on the mine, so there would be an increasing call for the supervision of a skilled engineer. Clearly, by 1833 a staff of men had been trained by Woolf who were able to carry on without his direction, for in that year, he was then sixty-seven years of age, he left Cornwall and went to live in the island of Guernsey. Why he selected Guernsey for the place of his retirement we cannot say, but he was not idle even there, for in the short period before his death on October 26th, 1837, he had put up a steam engine to drive a flour mill.

Whether we regard him as an inventor or not, it is to Woolf that we must concede the successful introduction of high-pressure working in the Cornish engine. At about the time that this was being effected James Sims, a son of William Sims, one of the best-known engineers in Cornwall at that time, was starting his career, and he has left us an interesting little account of his experiences. Of the performance of the Wheal Abraham engine he says it "awakened the whole of the Cornish engineers to a new era in steam power, and many a sleepless night have I had, with others, in repairing the many breakages of engines and boilers, caused by the boilers being too weak for the steam attempted to be used, and the material of the engine not being strong enough for the concussion given by the sudden admission of much higher steam on the piston than was originally intended." Another writer, Lean (Historical Statement, 1839), who was in close touch with all that was being done, says: "To him we owe the establishment, if not the introduction of high-pressure steam with expansion and condensation."‡

Perhaps we can leave the matter at that: Woolf showed the Cornish engineers that large engines could be built to work with high-pressure steam and condensation, and built to work successfully in continuous operation. Moreover, he taught them how to make such engines, for it is admitted on all sides that as a mechanical engineer he was in the first rank.

* The Newcomen Society for the Study of the History of Engineering and Technology, Caxton Hall, Westminster, January 18th, 1933.

† "James Watt and the Steam Engine," 308.

‡ Lean's "Historical Statement. . . Steam Engines in Cornwall," 1839, contains tables of the performances of engines in Cornwall for certain selected years. The writer has to thank Mr. W. A. Michell, of Redruth, for valuable notes from the Monthly Reports.

SIXTY YEARS AGO.

ALTHOUGH the destroyer is still an item—and an important one—in the navies of all maritime Powers, no country now builds the type of craft which these vessels were originally designed to destroy. The torpedo boat was at one time a definite naval type and the torpedo-boat destroyer was devised to counter it. The destroyer remains while the torpedo boat, as such, has passed away. It might perhaps be more correct to say that the destroyer and its prey have become merged in one type, for all destroyers are now equipped to carry out attacks by torpedo and also with means for engaging other vessels similarly equipped. That the two types of vessel were at one time completely distinct is recalled by the description which we published in our issue of January 24th, 1873, of a "steam torpedo launch" built by Yarrow and Headley at the Isle of Dogs, Poplar, and representing the famous firm's first connection with the construction of naval vessels of the torpedo-boat type. The launch had been built, we recorded, for a foreign Government and had been constructed under the superintendence of Mr. Hunter Davidson, of the United States Navy. It had a length of 30ft., a beam of 6ft. 6in., and a draught of 2ft. 6in. Its engines, using steam at 70 lb. pressure, were designed to give it a speed of 8½ statute miles an hour. After leaving the cylinders the steam passed into a large chamber before being exhausted up the funnel, the object sought being to make the approach of the vessel to its target noiseless. Forward of the funnel was a dome-like steel shield, within which the steersman and one or two other members of the crew were to take up their station before an attack. Aft the engineer was protected from rifle fire in a similar manner by means of a sliding steel shield, which he could draw over his head. Although the Whitehead self-propelled torpedo had at that date been invented and was giving promising results, the launch made use of the form of "torpedo" which had been employed during the American Civil War. A charge of dynamite was carried at the end of a long pole, wnich just before an attack was to be made was fixed to project forwards from the bows and sloping downwards. The charge was stated to be sufficient to penetrate the thickest plates of the largest vessel afloat and was fired electrically by a galvanic battery just at the moment of contact. The torpedo pole was made of teak and in its hollow interior contained two copper wires leading from the battery to the explosive charge. It is not very clear whether the firing of the charge was effected by a man stationed beside the steersman in the forward shield or whether it was brought about automatically on the contact of the charge with the side of the target ship. We were not at liberty to go into full details. What, it may be asked, would be the fate of the crew of the launch after they had charged against an enemy ship like a knight of old with an explosive head to his spear? If they escaped without loss from rifle fire it would appear that they had no occasion to fear destruction from their own torpedo. It had been found from repeated experiment that if the explosive charge was at least 22ft. in front of the launch and was fired at least 7ft. below the surface of the water the water would form a barrier sufficient to give them ample protection from the explosion.

THE INTERNATIONAL ALUMINIUM COMPETITION.

IT will be recalled that the world producers of aluminium decided to renew in 1932 the International Competition, open to technical workers in every part of the world, originated with the object of awarding prizes for the best suggestions made relative to the use of aluminium and its alloys.

The competition jury, which met in December of last year, allocated the 20,000 (Swiss) francs voted for the prize money as follows:—4000 to Dr. Eckert, of Grevenbroich (Germany), for his researches on the protection of aluminium and its alloys by the M.B.V. process and the improvements made in this process; 4000 to Mr. Philippe of Paris (France), for his memorandum on the use of aluminium alloys in gas or oil-fired central heating plant; 3000 to Mr. Y. Hirakawa, of Yawata (Japan), for his article on aluminium tuyeres for blast-furnaces; 3000 to Mr. Th. Schweizer, of Zürich (Switzerland), for his memorandum on the use of aluminium for grain silos; 2000 to Mr. Py, of Paris (France), for an improved model of an aluminium alloy bicycle; 2000 to Mr. Steinborn, of Rodange (Grand Duchy of Luxemburg), for his study of the possibilities of the use of aluminium and its alloys in blast-furnaces and steel works; 2000 to Mr. H. Tatu, of Lyons (France), for his memorandum on the use of aluminium in dyeing and cleaning.

The International Aluminium Competition for 1932 met with a better response than that of 1931 in the technical circles of most countries. More than 1000 persons addressed inquiries to the Bureau International de l'Aluminium as to the details of the competition, and 405 memoranda were received, which in the great majority of cases were based on serious investigations and showed an expert knowledge of the light metals.

IN the course of a paper on "The Essentials of Good Welding," Mr. A. G. Walker stated that a good test for the correct tint of glass was to weld for about 10 minutes and then to remove the goggles and look into the darkest corner of the shop. If everything can be seen distinctly, the tint may be taken as correct, but if there is a ring of white light the colour is too pale. On the other hand, if it is necessary to close the eyes slightly the tint is too dark.

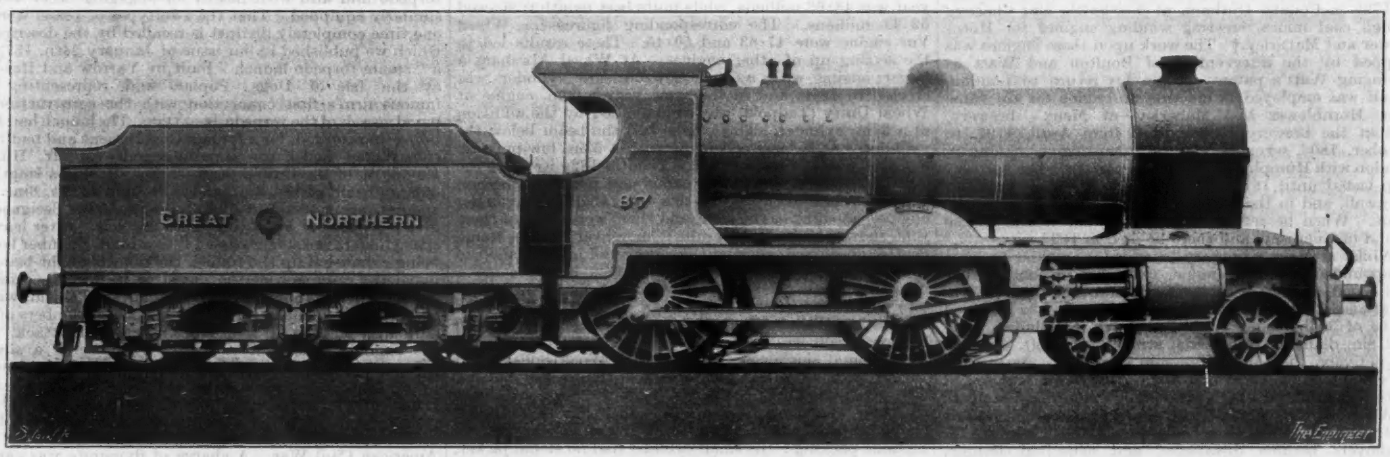
Three-Cylinder Compound Locomotive

Great Northern Railway (Ireland).

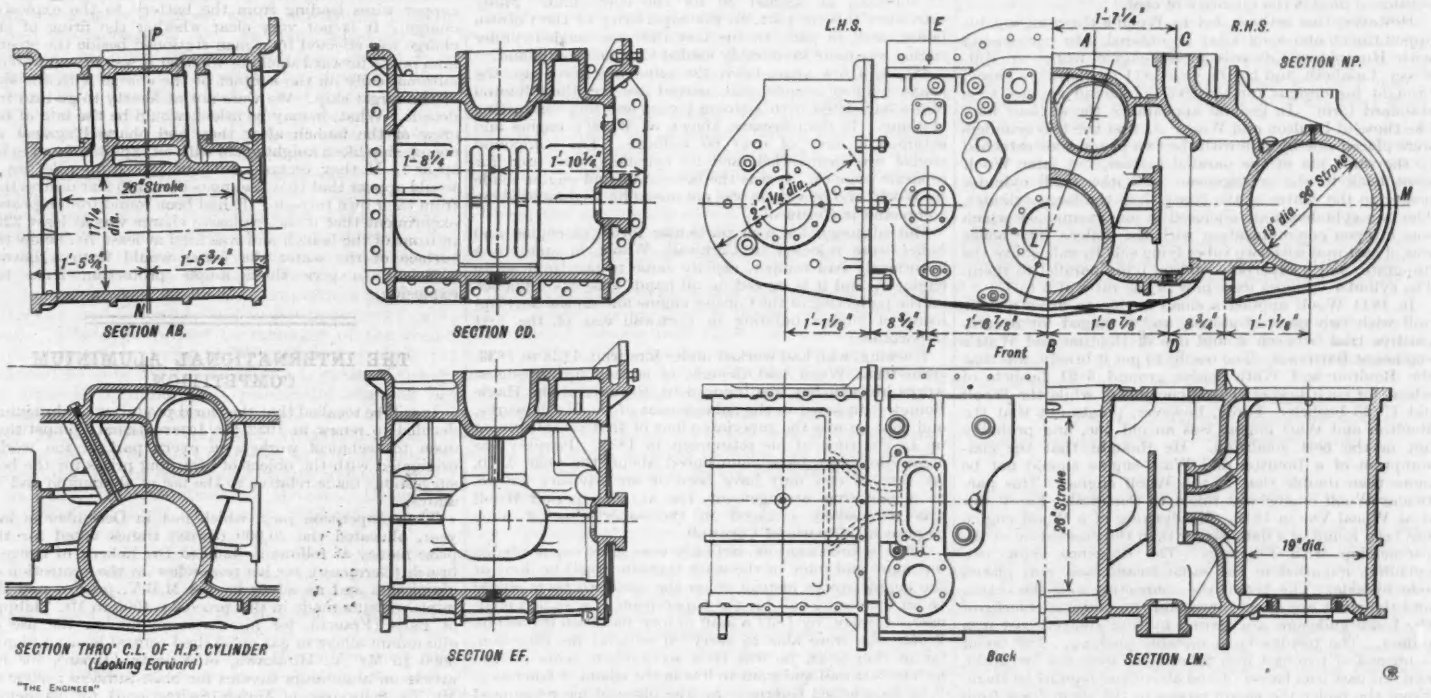
FOR forty years the compound locomotive has been in use in Ireland. In 1890 a number of engines on the Worsdell and von Borries two-cylinder system were delivered to the Belfast and Northern Counties Railway, and in 1896 the same system was tried on the Belfast and County Down and the Great Southern and Western Railway. There still remain nine passenger and two goods compound engines on the L.M. and S. Railway (Northern Counties Committee). The B. and N.C.R. locomotives, built by Beyer, Peacock, were illustrated in THE ENGINEER of November 20th, 1896. All these engines were worked at what we should now call low pressure—about 170 lb.—and could not take full advantage of the high ratios of expansion made available by compounding.

It is very interesting to find that the compound is being revived again in Ireland as in this country, and we congratulate Mr. George T. Glover, M. Inst. C.E., locomotive engineer, Dundalk, on the three-cylinder locomotive which he has just introduced on the Great Northern Railway (Ireland). This engine, which was built by Beyer, Peacock and Co., Ltd., takes full advantage from compounding by employing a boiler pressure of 250 lb., and, as will be seen from the drawings on this page, and particularly those which are presented as a Supplement with this issue, represents the latest locomotive practice.

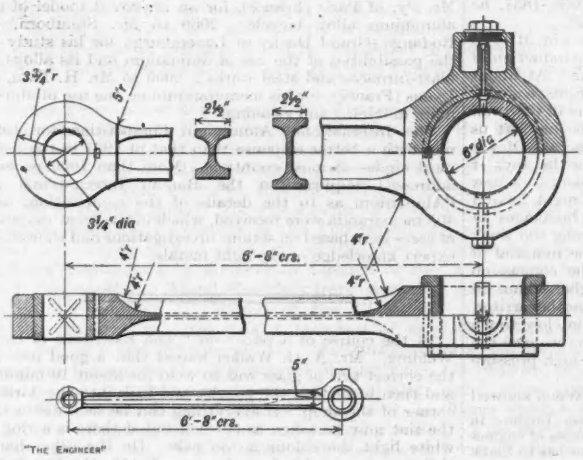
The compound system employed is that of W. M. Smith, now a standard on the L.M.S. Railway, which has 240 locomotives of the kind in use. In the hands of Sir Henry Fowler, many details were improved, and Mr. Glover desires to express his thanks to Sir Henry and his successor at Derby, Mr. E. J. H. Lemon, for the help they gave him in the design of his new engine. The Smith system owes much of its popularity to the simplicity of working from the driver's point of view, and this simplicity is largely due to the "Derby" regulator, a diagram of which is given herewith. From this diagram it will be seen that in the first 32 deg. of arc of movement of the regulator handle steam is admitted to all three valve chests, thus giving a large torque for starting or for heavy collar work. The remainder of the movement of the starting handle admits steam to the H.P. cylinder alone. To return to the original conditions—semi-compound, as it is called—the regulator must first be fully closed. Referring in detail to the regulator diagrams, A represents the entrance of an auxiliary pipe leading direct to the L.P. valve chests, and B the opening to the main steam pipe. The regulator consists of a main slide with a jockey slide on its back. Taking the group of valve positions on the right, it will be seen that in position 1 all the ports are closed. In position 2 the jockey has been moved to the left, with the result that steam is just beginning to enter A. At the



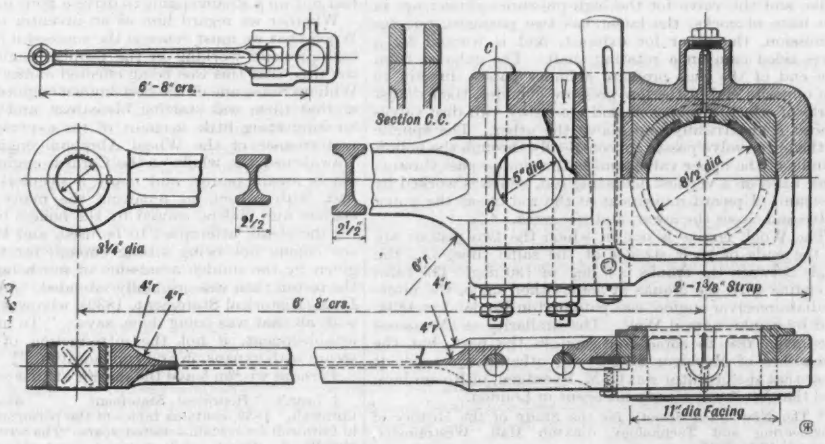
THREE-CYLINDER COMPOUND LOCOMOTIVE



THE MONOBLOC CASTING FOR THE THREE CYLINDERS



L.P. CONNECTING ROD



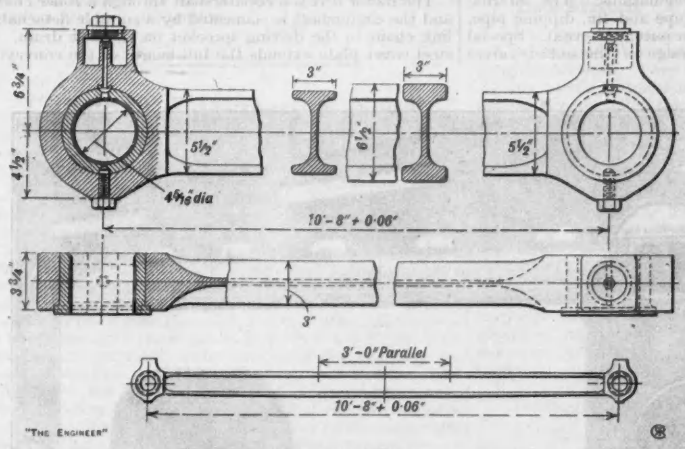
H.P. CONNECTING ROD

same time ports C and C¹ are beginning to register and to permit a little steam to enter the main steam pipe leading to the H.P. cylinder, thus giving the "semi-compound" condition. In the next two positions, 3 and 4, the admission of boiler steam to the L.P. chests and to the main steam pipe has increased. In position 5 the regulator handle has begun to move the main slide and in position 6 this movement has closed the auxiliary pipe A and begun to open the main steam passages. In position 7 the regulator is full open for compound working. The sequence of operations for closing is shown on the left of the diagram.

In order to prevent the receiver steam from acting against the H.P. piston, when starting or working semi-compound, a non-return valve is fitted at each end of the H.P. cylinder. These valves permit steam to enter the H.P. cylinder whenever the receiver (L.P. valve chests) pressure is higher than the internal pressure,. To put the H.P. piston in equilibrium when the regulator is shut, two single type by-pass valves are fitted.

Another essential feature of the Smith compound is the crank arrangement. The two L.P. crank pins are at right angles to each other with the H.P. at 135 deg. to them. The valve gear is so arranged that the maximum cut-off in these cylinders is later than in an ordinary two-cylinder engine, so that an abnormally large starting effort can be exerted. The three cylinders in Mr. Glover's design are cast in one, as shown above, thus getting rid of two awkward joints. The cylinder casting without covers, &c., weighs 4¼ tons, and acts as a useful stay at the front end of the frames. The pistons of all three cylinders are of cast steel with bronze rims cast on. The high-pressure valve is of the piston type, but the L.P. valves are balanced flat valves of bronze. The pressure on these valves is low, and as they relieve themselves automatically by lifting from their seats, they are fully justified in this position.

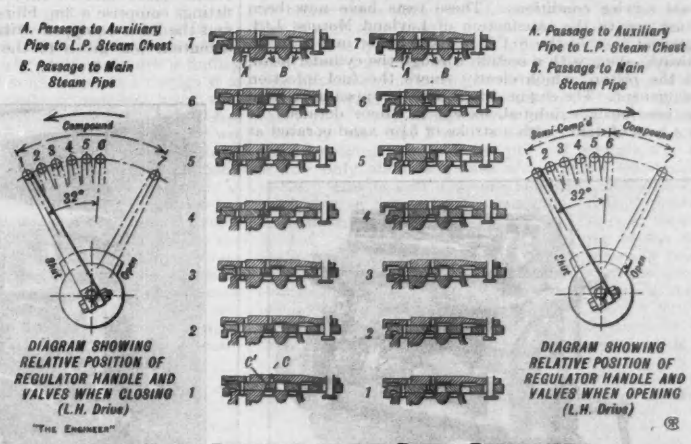
It is well known that a three-cylinder arrangement can be more easily balanced than a two or four-cylinder, and the hammer blow diagram of this engine will be examined with interest. It has been prepared in the manner stipulated by the Bridge Stress Committee of 1928, and shows that the excess load for the whole engine is only 1 ton at six revolutions per second. The driving axle load is 21 tons, but at 84 m.p.h. the total weight—static and hammer blow—on the four coupled wheels of 3 c.c. is 7 tons less than the total weight on similar wheels for the much less powerful two-cylinder engines which the new design replaces. We may add that the reconstruction of the bridges at Drogheda and Malahide by Mr. G. B. Howden, M. Inst. C.E., the chief engineer of the company, enabled the higher axle load to be used.



COUPLING & ROD

The engines are fitted with the company's standard tender of 3500 gallons capacity, and are capable of high average speeds, with loads varying from 200 to 350 tons behind the tender. For example, with a train of seven bogie coaches, weighing 220½ tons, behind the draw-bar, a diagram before us shows that between Howth and Donabate, on a fairly level road, a speed of 65 to 70 m.p.h. was maintained, and that after a coach had been slipped at Drogheda, reducing the load to 188½ tons, a speed of about 84 m.p.h. on the down gradient between Kellystown and Dunleer was reached, and was kept up thence with slight variations until approaching a stop at Dundalk. The coal consumption averages from 39 lb. to 45 lb. per engine-mile, according to the weight of the train, with Scotch coal of approximately the following analysis :—

Calorific value in B.Th.U. per lb.	14,539
Ash	5·9
Moisture	3·1
Fixed carbon	56·0
Volatile matter	35·0
Total sulphur	0·95


A. Passage to Auxiliary Pipe to L.P. Steam Chest
B. Passage to Main Steam Pipe
Compound
Short
Long
32°
DIAGRAM SHOWING RELATIVE POSITION OF REGULATOR HANDLE AND VALVES WHEN CLOSING (L.H. Drive)
Semi-Comp'd
DIAGRAM SHOWING RELATIVE POSITION OF REGULATOR HANDLE AND VALVES WHEN OPENING (L.H. Drive)
"THE ENGINEER"

VALVE POSITIONS OF THE DERBY REGULATOR

Glass Bulb Rectifiers.

THE fact that glass bulb rectifiers are about to be employed for supplying current to trains on the L.M.S. Liverpool-Southport and Manchester-Bury lines is an indication that very marked progress has been made in the construction of these rectifiers since they were first introduced. Small units, capable of delivering 5 or 10 ampères and intended mainly for charging accumulators, were manufactured in this country about 1909 and were followed by 20, 30, and 40-ampère units for D.C. pressures up to about 220 volts, but the details of construction differed radically from those of the heavy duty rectifiers made to-day. Whereas at the present time seals can be made suitable for several hundred ampères, carried by a single piece of metal, it was originally necessary in the case of a 40-ampère bulb, for example, to employ at least four platinum wires at the seal. Nevertheless, some of the small units constructed in this way as far back as 1909 were in satisfactory service up to 1923.

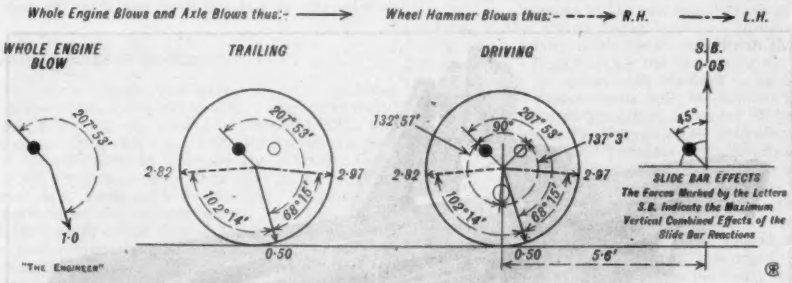
In the early days Continental manufacturers were somewhat in advance of this country as regards output, for whereas the maximum D.C. capacity of British-made rectifiers was 40 ampères, those made abroad could deliver up to 100 ampères. In 1920, however, the Westinghouse Cooper Hewitt Company, now the Hewittic Electric Company, of Hersham, Walton-on-Thames, saw the possibilities of large glass rectifiers for automatic sub-stations and developed units capable of delivering 150 ampères at D.C. pressures up to 550 volts. Naturally, difficulties were experienced in convincing engineers that a glass container was sufficiently robust under these conditions, but eventually some 100-kW equipments were installed and gave fairly satisfactory results. A disadvantage of the original units was that they were not provided with exciting circuits, and when the load dropped to a low value the bulb ceased to operate. The first scheme adopted to maintain the arc involved the use of a loading resistance; but, needless to say, this proved inefficient and the present exciting system was ultimately evolved. The capacity of the bulbs then increased from year to year. From 150 ampères at 500 volts the output rose to 200 ampères, then to 250, 300, 400, and 500 ampères per bulb, whilst to-day it is possible to obtain a basic load of 375 kW from a single bulb with overloads of 25 per cent. for two hours and 100 per cent. momentarily. At the higher pressures, such as 20,000 volts, it is said to be possible to draw 1000 kW from a single bulb.

The glass bulb rectifier is now being employed for many classes of work involving conversion from A.C. to D.C., and fully automatic glass rectifier sub-stations are operating in this country with outputs up to 6000 kW. A certain amount of difficulty is naturally experienced in handling the large amount of glass that is necessary for the manufacture of the highest capacity bulbs, and it is said that there are only a comparatively few men in this country who can grapple with the job. Careful attention has also to be paid to the composition of the leading-in metal and the properties of the glass. Owing mainly to the nature of the seals the average life of the bulbs in the early days was only a few years, but with seals made in accordance with modern practice and with glass of suitable strength it is claimed that even with the heaviest overloads met with on electric railways the bulbs have a life of many years.

Grid-controlled glass bulb rectifiers by means of which D.C. can be converted into A.C. or the voltage can be varied in fine increments, very much in the same way as

400 AMP. 500 VOLT GRID-CONTROLLED RECTIFIER

that of a shunt-wound generator, were recently brought to our notice at the Hewittic Electric Company's works. The possibility of regulating the voltage in this way, the Hewittic engineers point out, is a great advantage in areas where the bulk of the load is dealt with by rectifiers, for in the event of an interruption of the A.C. supply the D.C. voltage can afterwards be brought up gradually from zero without the risk of one sub-station taking up more load than another. Besides having equipped the largest glass bulb rectifier sub-station in existence with a capacity of 6000 kW, the Hewittic Company also claims to be the first concern in this country to have supplied grid controlled glass rectifiers for commercial use. Two Hewittic rectifiers of this kind have been put into cinema palaces, where they are being used to charge batteries at variable voltage, thus obviating the necessity for a motor generator or other machine. The accompanying illustration shows a 400-ampère, 500-volt grid-controlled rectifier at the Hewittic Company's works.



Max. Slide Bar effect on each rail = WH 0·39.
Angle between combined Slide Bar effects and both Rail effects 87°.
The Right Hand effect reaches its max. first during rotation of Driving Wheels.
The Right Hand Side of the Engine is shown. The shaded Crank is the Outside L.H. Crank Pin.
Hammer Blows are expressed in Tons at 5 Revolutions per Second.
Whole Engine Blows and Axle Blows are shown by full arrows and their direction indicated by the Angle by which the arrows are in advance of the outside L.H. Crank Pin.
Wheel Hammer Blows are shown by dotted arrows and their direction indicated by their angular positions relative to the corresponding Axle Blow.

HAMMER BLOW DIAGRAMS

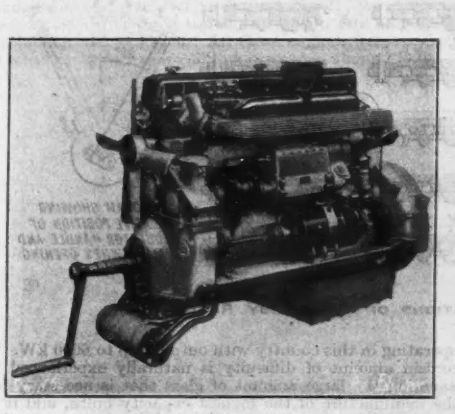
In addition to the balancing of these locomotives, great attention has been paid to the design of the connecting and coupling-rods, the latter being of the unusual length of 10ft. 8in. between centres, in order to obtain the advantages of a level grate and avoid the disadvantage of steeply sloping fire-bars. The design is shown. The thickness of webs is ¾in. The H.P. connecting-rod weighs 480 lb., and the L.P. rods 276 lb. each, and the coupling-rods 410 lb. each. They are constructed of "Tormol" steel, supplied by D. Doncaster and Sons, Ltd., Sheffield. This steel was chosen in order to obtain the advantages of the high elastic limit, the results being as follows :—

Yield stress	43·7 tons per sq. inch
Maximum stress	54·8 tons per sq. inch
(A ratio of yield to maximum stress of 79 per cent.)	
Elongation	24·5 per cent. on 2in.
Reduction of area	63·7 per cent.

ABRASIVE cutting-off wheels are being increasingly used for cutting off bar stock and tubing at very high speed. On a modern type of cutting-off machine, for example, an abrasive cutting-off wheel will cut off steel rods, 1¼in. in diameter in from 1¼ to 2 seconds, leaving a clean, smooth cut. These wheels can be run at peripheral speeds up to 16,000ft. per minute. They are made in thicknesses of from ⅛in. to ¼in.

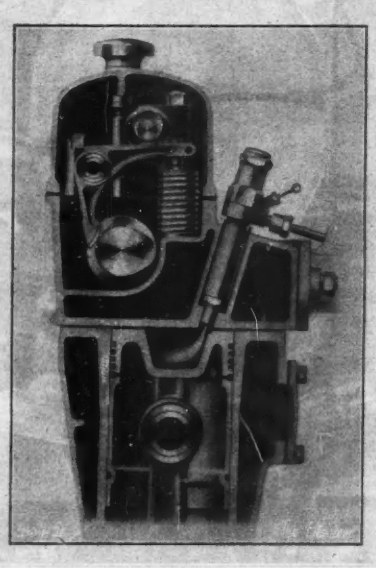
The Leyland Oil Engine.

AT the Commercial Motor Transport Exhibition, held at Olympia in 1931, the Leyland oil engine, which has been developed during the past five years, was exhibited, but at that time it had not undergone the requisite tests under actual service conditions. These tests have now been carried out to the satisfaction of Leyland Motors, Ltd. A general view of the 8·1 litre six-cylinder unit is given herewith, along with a section through the cylinder head, and the piston, which clearly shows the fuel injection arrangement. The engine differs little in appearance from that previously exhibited, except in minor details. It has a bore of 4⅛in., with a stroke of 5½in., and is rated at



SIX-CYLINDER HIGH-SPEED LEYLAND OIL ENGINE

45·7 horse-power. It is governed at 1800 r.p.m., at which speed an output of 88 B.H.P. is developed, this power and speed being definitely limited to ensure a sustained output with reasonable fuel consumption and maintenance costs. The engine has an "Elektron" crank case, and its weight is but little greater than that of a petrol engine of similar size. The design of the parts has been so contrived that many components, such as the clutch, the sump, and the timing gear details, are common to both the petrol engine and the oil engine, while the two units are interchangeable in the chassis. The engine and the gear-box form a compact unit with three-point mounting in the frame. All auxiliaries with the exception of the starter motor are mounted on the near side, giving a neat lay-out. As an overhead cam shaft is employed, there are no



SECTION THROUGH PISTON AND CYLINDER HEAD

tappets and push-rods, so that a simple cylinder block casting is obtained, with accessible holding-down bolts. The cylinder head takes the form of a single iron casting carrying all the valve gear. It may be quickly removed for valve grinding or adjustment on the bench, while a spare head can be fitted in less than one hour. Direct injection is employed, and the combustion chamber is a simple cup formed in the top of the piston. As will be seen from the section, the piston cavity is slightly displaced to one side, and as the fuel is injected obliquely toward the piston centre it is kept well away from the cylinder walls, where its presence might detrimentally affect the piston ring lubrication or possibly cause crank case dilution of the lubricating oil. As the engine has, we learn, been thoroughly tested by the builders under actual road conditions, further service results will be awaited with interest.

2500-Gallon Petrol Tank.

IN the accompanying engraving we illustrate a 2500-gallon, five-compartment petrol tank, mounted on a Leyland Hippo chassis. The tank has been built by Thompson Brothers (Bilston), Ltd., for transport of Pratts High-Test petrol for the Anglo-American Oil Company, Ltd. It is of the builders' registered elliptical design, electrically welded, the length of the barrel being 23ft., with an overall length over the die-pressed and flanged ends of over 28ft. 8in. The barrel of the tank is constructed in longitudinal strips of ¼in. mild steel plate, the ends being made of ⅜in. steel and the divisions of ¼in. steel. The major axes of the elliptical ends is 6ft., with a minor axis of 4ft. Each of the five compartments is fitted with a 1ft. 4in. internal diameter pressed manhole, with a specially designed aluminium lid, conforming to both Home Office and to L.C.C. regulations. The internal fittings comprise a 3in. filling pipe and 4in. dipping pipe, and the lid is equipped with an automatic vent. Special attention was given to the design of the outlet valves

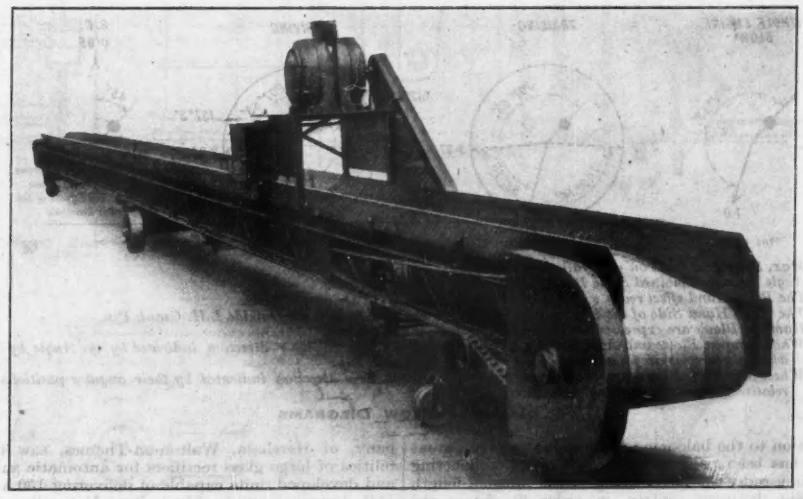
2500-GALLON FIVE-COMPARTMENT MOBILE PETROL TANK

and piping, and the approximate time required to empty 500 gallons from any compartment is 7 minutes. The tank is mounted on the Leyland chassis by means of patented detachable all-steel mountings, and the sides and front and rear ends are enclosed by 14 s.w.g. aluminium panelling with cylindrical windows for display purposes. The design includes the provision of chromium-plated handrails above the walk platform, which are carried down alongside the small steps between the tank and the back of the panelling. Inside the panelling there is provision for carrying four 12ft. 6in. lengths of 3in. diameter hose piping. The chassis and engine follow the standard specification for the Leyland "Hippo" three-axle goods vehicle, the engine being a six-cylinder unit with a 4⅛in. bore and 5½in. stroke, with a designed output of 72·7 B.H.P. at 1000 r.p.m., giving speeds from 2·5 up to 14 miles per hour.

Horizontal Portable Belt Conveyor.

A SELF-CONTAINED unit for dealing with material dumped in elongated piles is shown in the accompanying engraving. This conveyor was supplied for the purpose of handling oxide as fed to the conveyor by hand from a ground storage position alongside. The material travels to bucket elevators and thence to storage hoppers. The machine is also adaptable for much coarser duty, such as the conveyance of coal, coke, cinders, and similar commodities.

Made by British Jeffrey-Diamond, Ltd., of Wakefield, Yorks., its general construction is similar to that firm's



HORIZONTAL PORTABLE BELT CONVEYOR

portable belt conveyor. The conveyor illustrated is 50ft. long and is of lattice construction, combining lightness with rigidity and strength. It is mounted on a pair of fixed road wheels at the centre of the conveyor boom and for slewing purposes suitable castors, a pair at each end, enable two men, at the most, to move the appliance into any desired position either lengthwise or laterally. High skirt boards are provided and large quantities of material can be carried without fear of spillage. Suitable troughed idler rollers carry the conveying portion of the belt, which is 16in. wide by 4-ply. Dependent upon the kind of material being handled, the capacity for all practical purposes is in the neighbourhood of 50 tons per hour.

The drive is taken from a totally enclosed electric motor of 3 H.P. capacity, conveniently mounted above the conveyor run. A removable cover is arranged for this as a protection against outdoor weather conditions. Petrol engine drive may be applied with equal facility.

The motor drives a countershaft through a roller chain, and the contershaft is connected by a suitable detachable link chain to the driving sprocket on the belt drum. A steel cover plate extends the full length of the conveyor, over the return belt, and sheds away any material which may be accidentally spilt, protecting the under surface of the belt. Tension adjusting arrangements are embodied for uniformly taking up stretch in the belt. These take the form of two screws at the delivery end, upon which trunnion bushes for the belt drum shaft are mounted. The drive and tail end bearings are lubricated on the high-pressure grease system.

A Cable Making Film.

A HIGHLY interesting sound film, entitled "Stranded in Prescot," was exhibited at the Cambridge Theatre on Friday, January 20th, by British Insulated Cables, Ltd. It is to be shown in various parts of the country in collaboration with local supply undertakings and contractors for the purpose of electrical propaganda, and although it naturally stresses the excellence of B I cables, house wiring equipment of all kinds, and other of the company's products, it should prove beneficial to the electrical industry as a whole. A striking contrast is made between the old sources of power, such as the windmill and watermill, and the modern power station. Comparisons are also made between existing systems of transport and lighting and those in vogue one hundred years ago. The film then shows a typical young suburban couple in search of electrical comforts for their home. A trifle doubtful, they visit their local showroom and the salesman explains to them how easily their house can be wired. The portion of the film which follows portrays the various departments of the company's Prescot works, in which the B.I. paper-insulated cables are made. The rolling mills and wire-drawing machinery are shown in operation; in fact, all the operations involved from the reception of the raw material to the despatch of the finished products are revealed, one of the most fascinating parts of this section of the film being that which shows the braiding "Maypoles" in slow motion. Following views of the bond shop, a department in which the waste wood left over in the manufacture of cable drums is chopped to make firewood, the export department, the

Huyton Quarry factory in which B.I. enamelled wire is made, come moving pictures of the Helsby works, near Warrington. Here a very good idea is given of how the rubber is prepared for rubber-covered cable; how the covering machines work, and the manner in which the braiding and lead-covering operations are carried out, and, finally, how the cables are tested. Cable-laying and joint-making are also covered by the film, which is really a very fine production.

Canadian Engineering News.

(By our Canadian Correspondent.)

Railway Problems.

WHILE the Royal Commission on Transportation in its report to the Canadian Government did not recommend amalgamation of the Canadian Pacific and Canadian National railways, subsequent discussions at sittings of the Senate Committee on Railways and Telegraphs have revealed a strong feeling in favour of such a measure being adopted. At one sitting, Senator Dandurand, Liberal Leader in the Upper House, stated that after his study of a large amount of the evidence laid before the Royal Commission, he had reached the conclusion that not only the head of the Canadian Pacific Railway, but also the chief officials of the Canadian National Railways were convinced that only a joint management of the two railways would be effective in making the imperative economies necessary to a rehabilitation of the railway transportation system. Anticipating the criticism that amalgamation would involve a too great centralisation of power, Senator Dandurand said that if amalgamation could go further in economies than could be effected under the plan provided for in the present Bill, no solid objection could be offered, and he cited the evidence of President Beatty, of the Canadian Pacific, that, while under co-operation with an arbitral tribunal, an abandonment of only about 2000 miles of track would be possible, under co-ordinations the abandonments would total 5000 miles. In its redrafted form, the Senate Bill which implements the report of the Duff Commission on Railways and Transportation guarantees that the trustees of the Canadian National Railways may not be removed as the result of ascent to power of a new political party. Under the old Bill the Government might effect removal of a trustee by reducing his salary to 1 dollar. Aside from the interest which the proposed legislation has aroused throughout the country, there is the very significant statement submitted to the Government by the Canadian National Railways that drastic economies effected in 1932 will produce a saving of possibly 35,000,000 dollars. So favourable is the statement that it shows that the whole National system can easily meet operating expenses, and even earn a surplus on operating revenue, when all the Transportation Commission recommendations are implemented. This does not mean that revenue will be sufficient to meet the funded debt charges plus operation, but it will mean that the railway can more than pay its way, disregarding accumulated debt. Taking into account the close co-operation between the Canadian National Railway and the Canadian Pacific Railway during the past ten months, it is believed that the Canadian Pacific will also show a very large saving during this period.

Salt Production in Saskatchewan.

The Simpson Oil Company, which is developing a salt well near Simpson, Saskatchewan, is preparing to install a refining plant, and expects to produce salt at the rate of 10 tons a day from the beginning of the New Year. The company in drilling for oil encountered salt at a depth of 3445ft., and has produced some 30 tons of salt by use of a small demonstration plant. Some pumping difficulty was encountered at the well, but it has now been overcome. The company is preparing to drill for natural gas to the east of Simpson, and, if successful, the gas will be piped to the salt well and used for fuel in the refining process.

Removing a Huge Cofferdam.

The world's largest cofferdam is being removed at West Saint John, New Brunswick. The dove-tailed sheet piling, in some places sunk to a depth of 90ft., was erected in connection with the 10,000,000-dollar new port development undertaken in 1928 by the Harbour Commissioners of Saint John. More than 125 men are working on day and night shifts with locomotives, dragline, and other equipment on the removal of the huge dam which held back the waters of the Bay of Fundy during excavation of the harbour extension and building of the new pier, a 700ft. concrete structure. The work of removal of the dam is expected to take five to six months, and during the operation about 500,000 yards of stone and clay will be removed by dredging, as well as some 200,000 yards by the drag lines. The steel piling to be removed weighs 4,000,000 lb. The cofferdam has a perimeter of 5880ft., while the area enclosed to permit dry excavation and concrete construction was 43 acres.

Mining Improvements.

The Grenada Mines, Ltd., whose properties are about 4 miles south of Noranda, in the Province of Quebec, are installing a new and larger mill, which embodies features new to Canadian mining. The mill has a 24ft. wheel, rotating in an upright position, and with buckets attached to the inside circumference which carry the ore to a height of 18ft. and drop it on to striking plates, eventually reducing the material to a powder. Several processes involved in crushing under present practice are reduced to one operation in the new mill, which is expected to cut the cost of ore crushing by 60 per cent. The new mill will have a capacity of 200 tons a day, which can be doubled by installing a companion wheel on the same shaft.

A DIRECT wireless beam telegraphic service has been inaugurated between Bombay and Japan.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Trade Situation.

THERE is no marked change to record in the general industrial situation in the Midlands and Staffordshire on the week. Very slowly additional work is finding its way to the factories and workshops, and though it is almost imperceptible the tonnage of material being consumed is increasing day by day. Orders for iron and steel are rarely larger than during recent weeks, but they are more frequent showing that users are still very cautious. The volume of inquiry is also growing, and is of a hopeful character. There have been no important movements in the material market. The Steelmasters' Association has reaffirmed selling prices, and reports are current of price movement activity in the raw iron branch, but up to the time of writing nothing definite is known of the decisions arrived at by blast-furnacemen. Foundrymen, however, do not appear to be under any apprehension of any advance in prices as a result of the deliberations of Midland and Cleveland smelters. In the general market position there is a latent strength and confidence in the future is maintained.

Pessimism Deplored.

Mr. Alexander Ramsay, addressing the West Bromwich and District Manufacturers' Association on the industrial situation, deplored the extraordinary wave of depression which had come over the people, and for which he did not think there was ground. He held that some progress had been made in the past year, and that the prospects were more hopeful. A substantial recovery had been made towards sounder foundations for our industrial system, and our industrial future. The advantages of tariffs were now beginning to be felt, while benefits from the Ottawa Conference would eventually make themselves evident, though it would, he thought, take a long time. Our credit in the eyes of the world had improved. Municipal schemes involving expenditure through the Ministry of Health were now easier to get through, which, he considered, was an encouraging sign. Mr. Ramsay said he was told with regard to heavy engineering that there was now, and had been for the past three months, a body of inquiry greater than had been experienced for two years, and that there was an expectation that orders would be placed if we could persuade people to take the capital risk, but so long as we kept depreciating the position, and talking and thinking depression, we should not make progress. In the machine tool trade, he was told, there had been an improvement, and with regard to constructional engineering matters were better. The demands on constructional engineers in respect of public works had been held up, but there was a reasonably good demand for constructional engineering for industrial works.

Pig Iron.

Midland blast-furnacemen report a moderately good request for foundry grade iron, but a very poor one for forge sorts. Makers of light castings are fairly busy, but there is no improvement in the heavy engineering trade. Contracts for the supply of foundry iron have been booked covering deliveries over a lengthy period, but furnacemen would welcome specifications for heavier tonnages. There is no price alteration, Derbyshire and North Staffordshire foundry being on the basis of £3 6s. for No. 3 and Northamptonshire £3 2s. 6d. Forge grades are £3 1s. and £2 17s. 6d. respectively. Quotations are per ton delivered to stations in the Black Country, and are subject to rebate to large buyers. There are considerable stocks at the furnaces—considerable, that is to say, in relation to the current volume of trade. Anything like an industrial revival would soon clear them, however and bring more furnaces into use. There is confidence in the future. Interest in the raw iron branch of the market centres in the efforts being made to eliminate wasteful competition between Midland and North-Eastern blast-furnacemen. Negotiations between ironmasters in these areas have, it is understood, resulted in an arrangement whereby this desideratum will be achieved. There is debatable ground in Yorkshire on which Midland pig iron has been strenuously disputing the ascendancy with the output of the Cleveland furnaces. Rivalries have developed elsewhere. Derbyshire smelters have been sending raw iron into Scotland, which Cleveland claims as its own preserve. By way of reprisal, Cleveland iron has been sent as far south as Birmingham. Notwithstanding the high cost of transport, it has been offered at the same prices fixed for Derbyshire makes. It is urged that wasteful competition can be got rid of on mutually advantageous terms without prejudicing the consumer. Some of the business now being done is unjustifiable on economic grounds, according to the argument. If iron of a particular quality is necessary for a particular manufacture, it will be available under the terms of an agreement now outlined, but not at prices unremunerative to the producer. It is reported that a scheme virtually agreed upon allocates certain areas for supply by the respective producing districts at non-competitive prices, and under it Cleveland pig iron values for the North-Eastern area are ruled by No. 3 description at £3 2s. 6d., but quotations are for delivery to consumer, whereas minimum prices since January, 1931, have been based on No. 3 at £2 18s. 6d. f.o.t. Under the altered conditions, charges for pig iron to consumers close to producing works are increased, but customers at a distance will in some cases obtain supplies at a lower cost than hitherto, as they will have no carriage charges. If the plan is what it appears to be, it should command approval as a useful advance towards that unification of effort which is an essential of national reorganisation.

Staffordshire Wrought Iron.

An encouraging feature of the finished iron trade in Staffordshire is the interest displayed by customers, who for some time have maintained an indifferent attitude. It is thought that this may mark the beginning of a more prosperous period in trade. There are those connected with the industry who for many months past have held and expressed the opinion that when industry once again gets on its feet there will be an increased call for best grade finished iron. In certain instances where steel has been tried out there is believed to be a likelihood of a return to the older metal. Staffordshire produces possibly the finest qualities of marked and Crown quality bars, so that in the event of the prophecy being fulfilled there should be better times ahead for the industry. In the common bar branch also there is a slight chance of betterment in the future. For some years now past local ironmasters have been ousted in this market by Belgian competitors, who have been marketing an inferior material suitable for the production of bolts and nuts and fencing at a very cheap rate. Continental prices have now advanced considerably, and No. 3 iron, which six months or so ago could be bought for half the price of Staffordshire bars, is now only about a guinea a ton below local makers' prices. This is still a severe handicap, but should the hardening of foreign prices continue, district producers of common bars may once again get a chance in their own market. At date, work is very irregular in the South Staffordshire finished iron mills, buying generally being of a hand-to-mouth nature. Marked bar prices are unchanged at £12 a ton, but quotations for Crown iron are being cut finely in the struggle for orders. A figure as low as £8 12s. 6d. is said to have been accepted by some firms, but there are undoubtedly producers in this area who would not do business at this figure. Common bars for the nut and bolt and fencing industries sell at from £7 15s. to £8 per ton. Iron tube strip is upheld at £10 7s. 6d. to £10 10s. per ton delivered.

Steel.

The position in the finished steel department is unaltered alike as regards demand and selling prices. The Steel Association at its monthly meeting confirmed prices on the basis which has prevailed for a considerable time, namely, angles, £8 7s. 6d., less 15s. rebate to users of British steel only; tees, £9 7s. 6d., less 15s.; joists, £8 15s., less 22s. 6d.; ship, bridge and tank plates, ¼in. and over, £8 17s. 6d., less 15s. Boiler plates sell at £8 5s. upwards. Steel plates are selling moderately well, but demand for joists and sections continues very quiet. Constructional contracts are scarce and lack tonnage. There has been some slight improvement in the tube industry. In the semi-finished branch there is more movement and local re-rollers are obtaining additional work. In a number of Black Country mills work is in progress on orders for small bars booked a short time ago, when Continental prices took a turn upward. Now that the foreign sellers have again increased their quotations, more business with home consumers is anticipated. Nothing has so far come of the endeavour to put the British billet makers on a more strictly organised footing, and this, together with fear that Continental prices may fall again, is restricting demand alike of home and foreign material. The failure of Continental industrialists to re-establish the cartel does not make for stability. It is understood a further meeting will be held next month. Foreign structural steel is being offered on the market at prices recently ruling; small bars and semis have stiffened somewhat. For small bars £5 18s. to £6 is quoted. There is no more to be had at the low prices at which supplies were secured a few weeks ago. About £5 is named for billets.

Scrap.

A better inquiry is circulating for steel scrap, especially from Welsh works, but some consumers are not prepared to pay the higher prices asked by merchants. South Wales buyers have conceded an advance of half a crown, but there is little more freedom of trading, inasmuch as sellers have now advanced their quotations from 30s. (Birmingham) to 32s. 6d. for heavy steel scrap.

Sheets.

Selling prices of galvanised sheets and of black sheets have been reaffirmed on the graduated basis fixed by the manufacturers' association. Though these prices are firmly held, market conditions are unsteady. Demand has not developed as was expected, and severe competition has to be met in overseas markets from Belgian sheet makers. Some orders are now coming forward from India and South Africa is expected to provide a larger tonnage of business in the near future. The home trade is maintained at recent levels.

Obituary.

The death has taken place of an outstanding figure in the Cannock Chase coalfield in the person of Colonel R. S. Williamson in his seventy-fifth year. He had a long association with the industrial, political, military, and general activities of the district. For over thirty years he was general manager of the Cannock and Rugeley Colliery Company, and took a great part in the affairs of the Coalowners' Association, holding the office of Chairman. In addition to his responsible duties at the Cannock and Rugeley Colliery, Colonel Williamson held the chairmanship of the directorate of the West Cannock Colliery Company, Hednesford. He was on the directorate of the Florence Coal and Iron Company, Ltd., the Shelton Iron, and Steel Company, Ltd., the Lilleshall Company, Ltd., C. and W. Walker, Ltd., and the Transvaal and Natal Collieries, Ltd. Colonel Williamson was a member of the Institution of Civil Engineers and of the Institution of Mining Engineers.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Overseas Trade in Textile Machinery.

EXPORTS of British textile machinery during December formed a satisfactory finish to a year which, generally, was by no means a satisfactory one in this branch, notwithstanding the fact that the aggregate shipments were in excess of those in 1931. Last month's

exports were above the average for the January-November period. The December total of 5642 tons, valued at £500,199, compared with 5790 tons and £495,279 in the corresponding month of the previous year, and included 3664 tons of spinning and twisting machinery, valued at £319,226, and 1402 tons of weaving machinery, valued at £103,976. Exports to British India last month, valued at £181,442, were somewhat lower than in December, 1931, but the market was still easily the most important. China's takings, of a total value of £49,893, occupied a poor second place. Exports to South American countries reached an aggregate value of £24,206, and these markets were followed by Australia with £22,193, the Netherlands £19,316, the United States £18,551, France £16,717, Germany £16,028, Japan £15,799, and Russia £1275. The total exports to "other European countries" during December were valued at £109,338, compared with £105,626 in the corresponding month of the previous year.

The Year's Improvement.

Last year's exports of textile machinery were substantially below those of 1930, whilst representing a slight improvement compared with the previous year. The shipments to British India, the Netherlands, China, Japan, South America, and Australia were all on a better scale than in 1931, but the takings of Russia, Germany, France, and the United States were smaller. The total for last year was 63,070 tons, valued at £5,511,157, including 42,623 tons of spinning and twisting machinery, valued at £3,770,236, and 15,199 tons of weaving machinery, valued at £1,097,366. The 1932 total compares with 55,567 tons and £5,280,713 in 1931, and 91,213 tons and £8,628,162 in 1930. The shipments to the individual markets, with the total for 1931 in parenthesis, were as follow:—British India, £1,934,680 (£1,749,429); China, £502,473 (£406,774); Japan, £336,848 (£263,368); South America, £319,827 (£236,627); the Netherlands, £204,099 (£200,262); Germany, £182,750 (£218,896); France, £181,748 (£441,258); Australia, £165,386 (£82,233); the United States, £129,835 (£159,454); and Russia, £81,755 (£157,175). The aggregate takings of "other European countries" last year valued at £1,046,497, compared with £993,030 in 1931.

Obituary.

Mr. Arthur Brothers, deputy chairman of Platt Bros. and Co., Ltd., textile machinery manufacturers, Oldham, and of Platt Bros. and Co. (Holdings), Ltd., and a director of Textile Machinery Makers, Ltd., died at his home in Eccles, near Manchester, on Sunday last, at the age of sixty-eight years.

Mr. Thomas Darwell Harrison, managing director of Harrison, McGregor and Co., Ltd., agricultural engineers, of the Albion Ironworks, Leigh, has died at the age of seventy-three years.

The death occurred on Sunday, at Chorlton-cum-Hardy, Manchester, of Mr. W. E. Bolton, proprietor of Messrs. C. Davies and Co., general engineers, City-road, Manchester, at the age of fifty-six years.

Non-ferrous Metals.

The non-ferrous metals market during the past week has been reasonably steady, and except in the case of spelter values current at the moment of writing are unchanged to about 7s. 6d. per ton dearer compared with a week ago. In the copper section users in most instances are confining purchases to near deliveries, and as heavy stocks of the metal are held, both here and in producing countries, standard brands have done well, not only to hold their own, but to move up to the extent of about 5s. per ton on the week. Buying interest in tin has been at a particularly low level, and the past week's turnover has been small. At one time further weakness in this section was in evidence, but prices rallied afterwards to show a net gain of 7s. 6d. per ton on balance. The market for lead has witnessed a certain amount of fluctuation, but at the moment of writing quotations are almost exactly where they were a week ago. Spelter has continued to display the weakness which has characterised it during the past month, slow buying being accompanied by a further loss of several shillings a ton.

Iron and Steel.

Sellers on the iron and steel markets here during the past week report a slow but gradual improvement in conditions, without being able to point so far to any particular upward movement in any direction. In the foundry iron trade there has been a slight expansion in the number of small-scale orders placed and in the aggregate tonnage covered by these. Contract buying, unfortunately, remains on rather a disappointing scale. The price position is unchanged, current quotations for delivery to users in the Manchester district being at 67s. per ton for Derbyshire and Staffordshire brands of No. 3, 65s. 6d. for Northamptonshire, 62s. for Derbyshire forge, about 82s. for Scottish No. 3, and 80s. 6d. for West Coast hematite. The demand for bar iron is very moderate, but prices keep up at £9 15s. per ton for Lancashire Crown quality material and £10 5s. for best bars. In the steel trade there is no indication of improvement in the heavy using industries, although for some of the lighter materials the turnover has shown a little expansion during the past few days. Bright bars are one of the relatively favourable sections, with a moderate business being done in special alloy steels. Boiler plates are fairly steady at about £8 10s. per ton for acid and basic qualities, small re-rolled bars at £6 15s., joists at £8 15s., sections at £8 7s. 6d., ship and tank plates at £8 17s. 6d., frame plates (including surface inspection charges) at £9 2s. 6d., and large diameter bars at £9 7s. 6d. Prices of Continental steel products on this market are steady at the recent advances, but business is quiet.

BARROW-IN-FURNESS.

Hematite.

There are no new features to report about the hematite pig iron trade, which continues to keep up to the level recently attained due to better home demand. Fortunately, the steel departments are taking fairly heavy tonnages of iron, and in some cases the whole of the present output is cleared. Stocks show signs of shrinkage at some works, and this is a welcome feature. The Continent is a customer, but is not taking much iron as yet, while America is still lacking as a customer. The business done with the Midlands is comparatively good. The iron ore trade continues to be moderate. Local mines have a fair amount of orders on the books on local account, but it would not be correct to say that they are anything like busy. The small number of furnaces in blast in the district, combined with the restricted demand outside the district, renders the market quiet. The imports of foreign ore are on the low side, but are better than they were. Steel is quiet, but the rail departments are working at present, as also are the hoop mills.

SHEFFIELD.

(From our own Correspondent.)

Steel Trade Conditions.

PROPHECIES of a general revival in the steel trade are not being fulfilled, developments since the opening of the year having failed to come up to expectations. Following the upward movement in December, business has fallen off in the crude steel and heavy engineering branches, and numerous important inquiries which, it was hoped, would result in good business have not been translated into actual contracts. Much of the business done is on a hand-to-mouth basis, and buyers are continuing to pursue a policy of caution. Billet makers in the Sheffield area complain of quietude and severe price-cutting from the North-East Coast. Quotations are in consequence irregular and often unremunerative. Flatness is general in steel-making alloys. Things are brighter, however, in the lighter steel section, and a number of individual firms report a bigger output of special lines of alloy steel and tools. More high-speed steel is being made than for a long time past, and expansion continues in stainless steel and magnets, with exports improving.

Railway Material.

The demand for railway material continues poor, but inquiries are better from India and the home railways, and there is a recurrence of demand from the Chinese Government Purchasing Commission out of the Boxer Indemnity Funds. Formerly, the Commission's requirements were all for materials for the reconditioning of the tracks of the railways in China, but now the inquiries, while including permanent way requirements, are for some passenger and freight rolling stock. Particulars are being asked now in regard to six locomotives, 2–8–0 type, with tenders, twenty-four passenger car underframes with bogies, all-steel wagons, a track motor car, push cars and hand trolleys, centrifugal pumps, and motors. The permanent way requirements are considerable, including 6160 tons of 35 lb. per yard rails and 266 tons of fish-plates, 29 tons of fish bolts and 198 tons of dog spikes, and seventy sets of turnouts of 35 lb. per yard rails. In addition, track jacks, rail benders, and rail saws are needed, as well as 110 tons of structural steel angles and plates, and approximately 25 tons of galvanised wire. The India Store Department is inquiring for a variety of sundries, and the South Indian Railway for steel tires.

Steel Production in 1932.

Statistics now available show that the output of steel castings and ingots in the Sheffield area (which includes Rotherham, Parkgate, and Stocksbridge) in 1932 was 765,000 tons, as against 775,800 in the previous year, a decrease of nearly 11,000 tons, whilst the output in Lincolnshire was 443,000 tons, compared with 392,400 in the year 1931, an increase of nearly 50,000 tons. Lincolnshire also produced in 1932 463,000 tons of pig iron, as against 412,300 tons in 1931. Figures indicate that the recovery of trade from the great coal stoppage of 1926 reached its peak in 1929, which, by comparison, was a remarkably successful year in the steel trade.

Refitment at Glass Works.

Work is being suspended at the Wombwell Works of Wood Bros. Glass Company, Ltd., affecting some 100 employees. The firm is compelled to take this step on account of the need for refitment, the furnace having burnt out, needing replacement. The chief works of the firm are at Barnsley, and it is endeavouring to transfer as many men as possible. It is hoped to re-start the Wombwell furnace in about two months' time.

£250,000 Road Scheme Postponed.

Intimation has been received postponing the new scheme recently devised for widening the roadway between Derby and Matlock, on the Manchester to London main road, at an estimated cost of £250,000. The Derbyshire County Council states that the scheme may have to wait until the return to prosperity.

Doncaster-Grimsby Trunk Road.

Work is to proceed on a portion of the trunk road scheme on the road A 18 from Doncaster to Grimsby. The section referred to commences at Crowle, and joins the existing road at Keadby Bridge. Slight subsidences have occurred from time to time on the existing road through the village of Althorpe, which is narrow, and one part actually impinges on the river Trent, and forms part of the bank. It is feared that unless the present heavy traffic is reduced the road at this point will sooner or later collapse into the river. It is understood that a grant has been obtained from the Ministry of Transport sufficient to enable the work to be carried on, although the extent of the grant is not the 85 per cent. which was available before the issue of the Economy Report.

New Stemming Material for Explosives.

A new stemming material, which, it is claimed, greatly reduces the risk of blown-out shots in coal mines, has been successfully demonstrated by Professor J. A. S. Ritson and Mr. H. Stafford, of Leeds University, before a gathering of mining experts. The new stemming material consists of three parts of coarse sand under 5 I.M.M. mesh, mixed with one part of clay, dried and ground to pass a 50 I.M.M. sieve. Five per cent. by weight of calcium chloride is added, together with sufficient water to make a stiff paste, so as to make a binding and non-drying element. This mixture has been shown to be far superior to clay alone, which is commonly employed. The difference in the behaviour between the old stemming material and the new may be judged from the fact that whereas with a clay-stemmed shot a tin canister, placed over the mouth of a vertical shot hole, was hurled 30ft. or 40ft. into the air, a similar canister placed over the mouth of a shot hole stemmed with the new material was barely dislodged from its place. The amount of explosive was the same in each case. The whole of the shot-firing operations at Fryston Colliery are now conducted with the new type of stemming, which, it is claimed, in addition to making for increased safety, results in a saving in the cost of explosives. With the new type of stemming over 15,000 shots have been fired at Fryston Colliery. The results of the shots have been subjected to the most careful observation, and in no case has any semblance of a blown-out shot been found.

Exhibition of Machine Tools.

From January 23rd to February 6th Alfred Herbert, Ltd., of Coventry, are holding an exhibition of modern labour-saving machine tools at their Sheffield showroom in Ellin-street. The machines are being shown in operation and a special demonstration is being given of the results obtained with "Ardoloy" high-speed cutting alloy. Included among the machines on exhibition are a drilling machine, two capstan lathes, a milling machine, a Lumsden vertical spindle surface grinder, and a Hordern, Mason and Edwards inclinable power press. Zeiss fine measuring instruments and Norton grinding wheels are also being demonstrated.

NORTH OF ENGLAND.

(From our own Correspondent.)

Iron and Steel Trade Optimism.

DESPITE the fact that there has been some falling off in business in iron and steel, optimism as regards the future still persists in North of England industrial circles. Orders have declined to some extent during the past week or two, but there are real grounds for believing that this decline is only temporary. The negotiations which have been taking place between the Cleveland and Midland pig iron producers to eliminate cut-throat competition and to arrive at an equitable price arrangement, whereby makers will be able to realise their costs of production at least, have had an upsetting influence on market operations, but it is generally believed that the new arrangements will in the end be of benefit to all concerned. Indications are not lacking of brighter prospects in both the iron and steel industries, and it is encouraging to record this week a further increase in works operations. The Wolsingham Steel Works have booked a number of orders, and as a result they are relighting one of their furnaces. Although it is uncertain how long these orders will last, and how many men they will employ, there is at least some satisfaction in seeing that the tide is turning. Shortly before the well-known steel works were taken over from John Rogerson and Co. by the Wolsingham Steel Company, almost three years ago, nearly all the employees (representing practically the whole of the working population of Wolsingham and a small percentage of the surrounding villages) were laid idle, and many of them have scarcely worked since. Since then the works have been maintained by a reduced staff, though recently a few more employees have been found work. Dorman, Long and Co., Ltd., Middlesbrough, have also secured a contract for 5000 tons of sheet bars for the West of England. This is one of the largest orders obtained for sheets bars for a considerable time. The significance of the order lies chiefly in the fact that until recently sheet bars, billets, and the like have been imported, as foreign producers were in a position to sell them cheaper than home manufacturers. The effect of the tariffs, however, has been to enable home producers to compete. The order for 5000 tons, although not exceptionally large, is quite a considerable one for that class of goods.

New Pig Iron Price Conditions.

The new terms of selling adopted by the Cleveland and Midland pig iron producers appear to have been received with mixed feelings by consumers. In January, 1931, the Cleveland ironmasters fixed minimum prices of pig iron for the home trade at 61s. for No. 1 foundry, 58s. 6d. for No. 3 G.M.B., 57s. 6d. for No. 4 foundry, and 57s. for No. 4 forge, and these prices have remained ever since. Orders cannot now be placed at these figures, which have been f.o.t. Cleveland and Midland producers have now virtually agreed to supply pig iron to particular districts at fixed prices that will be non-competitive. Under the scheme quotations will be for delivery of iron to consumers in a certain district, so that the purchasers on the fringe of the area will be able to buy on the same terms as are charged to consumers close to producing works. The new conditions impose higher cost on uses near the blast-furnaces, but in some cases afford price relief to the consumers at a distance, who, under the altered terms, will have no carriage charges. For delivery to firms within the area agreed upon, No. 1 Cleveland foundry iron is now 65s., No. 3 G.M.B. 62s. 6d., No. 4 foundry 61s. 6d., and No. 4 forge 61s. The volume of business contracted during the past few days has been somewhat limited, but the tone of the market is confident.

Hematite Pig Iron.

No change has been made in regard to the selling of East Coast hematite pig iron. The market on this commodity will still continue on a free basis. Producers continue to be hampered by heavy stocks, which are not being reduced to any extent just now. Prospects for

increased trade, however, are stated to be a little brighter. For No. 1 grade of iron 59s. 6d. is asked, and for ordinary qualities makers keep the market quotation at 59s., but consumers experience no difficulty in covering requirements at well below these figures.

Ironmaking Materials.

There is little business passing in the foreign ore trade. Consumers have large stocks on hand. Best Rubio ore is nominal at 15s. 6d., c.i.f. Tees. Good medium blast-furnace coke is about 16s. delivered to North-East Coast works.

Manufactured Iron and Steel.

Business in the finished iron and steel section continues dull. In the heavy steel trade specifications are mainly for small quantities, and there is little call for shipbuilding and railway material. Producers of semi-finished steel have better order books than for some time. Prices all round are unchanged.

The Coal Trade.

A strong position is maintained in the Northern coal trade. At the moment, however, there is a wide divergence of opinion as to what the position of the coal export trade is likely to be in the next few months. Some merchants assert that the recent strength in the market was due to deferred buying on the eve of Christmas, and that the inquiries from abroad have been very scarce throughout this month. Exporters in close touch with every phase of the European market declare that this will be a bad year. At the present time, however, there is a strong home demand to augment export business, and the collieries are working regularly. Reciprocal trade agreements may be a great benefit later on, but when contracts come to be made the prices will have to be to customers' liking or they will probably go elsewhere for supplies. The consumer abroad will, so far as his own local conditions permit him, prefer British coal, but directly the price tends to go up his interest evaporates. In the meantime there is a distinct improvement in the inquiry for steam coal, particularly the best descriptions, which is mainly attributed to the colder weather on the Continent during the past few days. Contractors are earmarking loading turns for three and four weeks ahead, and anticipate being able to ship full commitments. This does not leave much free coal on the market, and holders of best Northumberland steams ask up to 14s. 3d., against 14s. offered. Second-hand sellers indicate 14s. for early parcels. Tyne prime steams are moving steadily, and are firm at 13s. 3d. to 13s. 6d., and other kinds are in sustained demand at 12s. 6d. Northumberland smalls are scarce at 8s. 6d., with Tyne primes at 9s. Durham best steam are firm for all dates of delivery at 16s., smalls being 11s. Durham gas coal is in better demand, and loading turns are filling up. Best qualities are fully booked for prompt, and are offered in moderate volume forward at 14s. 6d. Special Wear gas are also quite steady at 15s. Secondary gas remain quiet at 13s. to 13s. 6d. There is a good demand for best Durham bunker coals, especially from the coaling stations. Supply is somewhat short of requirements for prompt, and sellers quote firmly. For February supply is more abundant, and offered at steady values. Best descriptions are 14s. 6d. and seconds 13s. to 13s. 6d. Coke prospects are fairly good, with the demand slowly increasing. Gas coke is in strong request, but trade is slow for want of supply. Best qualities command 18s. 6d. and vertical 22s. 6d. Patent oven coke is in slightly improved demand at 15s., with superior makes at 16s. Coke nuts remain steady at 16s. to 17s.

SCOTLAND.

(From our own Correspondent.)

Shipbuilding.

IT is reported that Yarrow and Co., Ltd., Scotstoun, have received an order for machinery and boilers for a destroyer similar to the four destroyers already under construction for the Portuguese Government. Two of the destroyers are already on the stocks at Scotstoun, but the other three will be laid down at Lisbon. All the machinery and boilers and a considerable proportion of the plating will be fabricated at Scotstoun and shipped to be assembled at Lisbon. The steel material for the hull of the fifth destroyer will be supplied and shipped to Portugal by the Steel Company of Scotland.

Kromhout Oil Engines.

An agreement has been entered into between Perman and Co., London, and J. G. Kincaid and Co., Ltd., Greenock, whereby Messrs. Kincaid become the sole British manufacturers of Kromhout marine and stationary oil engines. The selling rights are retained by Messrs. Perman and Co., who will deal with all inquiries for Kromhout engines. The Kromhout engine is intended especially for coasting vessels, trawlers, &c., and it is intended to introduce an engine of improved design to meet the requirements of such craft.

Steel.

Producers of heavy steel cannot report any appreciable improvement so far, but in view of recent shipbuilding orders the position is regarded as being more hopeful. Black steel sheets are in good demand, considerable quantities having been bought for Japan. Business has been largely in light black sheets, the heavy gauges of black sheets and galvanised descriptions being rather neglected. Actual business in tubes is comparatively quiet, but the inquiry is maintained and the outlook appears to be more favourable. Prices are unchanged.

Iron.

The market for bar iron and re-rolled steel bars remains dull. Bar iron is unchanged at £9 15s. home and £9 5s. per ton export, and re-rolled steel bars at £7 5s. home and £6 10s. per ton export. Home prices are fixed, but with regard to re-rolled steel bars the export quotation may be affected by the keen prices quoted across the border.

Pig Iron.

The output of the two furnaces in operation continues ample to meet all requirements, and the production is not likely to be increased except on occasion to replenish stocks. Last week 300 tons of pig iron arrived in this district from Millom. The net selling price of pig iron during October-November and December has been certified at £3 5s. per ton. This means that the wages of the workmen will be reduced by 2 per cent. on basis rates. Shipments of pig iron from Glasgow last week amounted to 197 tons (177 tons foreign and 20 tons coastwise), compared with 331 tons (300 tons foreign) in the same week last year.

Coal.

Export demands for Scottish coal have not yet broadened out to any extent. Screened fuels, as a rule, are fairly well booked, some until the end of next month, but other descriptions are fairly plentiful. Industrial requirements show little expansion, but domestic demands have increased considerably owing to colder weather. Washed nuts are now the weakest feature of the market, although prices have not yet fallen to any extent. Aggregate shipments amounted to 255,709 tons, against 228,199 in the preceding week and 212,745 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

The Coal Trade.

SINGULARLY little development or movement in the coal trade has been in evidence in this area during the past week. Considering the comparative inactivity which to all outward appearances prevails in the matter of new business, it is surprising that shipments keep up as well as they do. The total for the six ports under the control of the Great Western Railway last week came to 407,925 tons, which compared with 443,365 tons for the preceding week and with 477,454 tons for the corresponding period of last year. The returns, in fact, were not quite as good as expected, in view of the good tonnage position reported at most of the docks in the early part of the week; but, as usually happens, the conditions were not so satisfactory towards the end of the week, when the number of idle tipping appliances reached forty-four. It is impossible to be very optimistic regarding the immediate future for the reason that chartering operations have been on the quiet side of late, so quiet, in fact, that outward rates of freight have been very depressed and in some instances rather than accept the rates that have been offered by merchants, shipowners have ordered their steamers to leave the Bristol Channel for their home ports to lay up. The weakness in the outward freight market has applied more particularly to handy-sized steamers engaged for the most part in the near trades. The market for larger tonnage keeps about steady for the reason that tonnage of this type is more widely distributed. Still, taking the conditions all round, they are not good for either the shipowning interests or the coal export trade, but dull as the coal trade is from the point of view of new orders, there is the prospect that with colder weather prevailing the demand from the near Continental ports will shortly show some improvement, though it should be pointed out that in the case of France shipments of most firms are well up to what they are permitted to send under the import quota. The great trouble of most of the steam coal collieries is the dearth of business for large coals, and as a consequence they are hampered in their output efforts and in many instances cannot keep pace with the demand for sized coals. Unfortunately, not only is the current inquiry for steam coals as a whole very restricted for prompt delivery, but there is no activity of any note in operations on contract account. Up to the time of writing no news was to hand of the allocation of the order for 21,000 tons of large coals for the Andaluces Railway of Spain, but it was expected to come about the middle of this week, while firms have not as yet been requested to quote for the reported requirements of the Norte Railway of Spain, which are said to be in the neighbourhood of 18,000 tons, but what the period of delivery is has not yet been disclosed.

The Coal Push.

For the best part of last week Mr. W. R. Gordon, the director of the Coal Utilisation Council, was in South Wales meeting the coalowners, coal factors, and coal merchants at Cardiff and Swansea for the purpose of gleaning information and bringing home to all concerned with the industry the objects of the Council, and preparing the way to a big propaganda movement for the extended use of coal instead of other fuel. The week terminated with an important gathering of industrialists, members of Parliament, and others holding important positions in the civic life of this district on the Friday evening, when the Lord Mayor of Cardiff presided at a dinner at the Cardiff City Hall, and an informal discussion took place on the best ways of restoring the prosperity of the coal industry. Furthermore, the gathering signalised the public co-operation of the Back-to-Coal Movement and the Coal Utilisation Council. In the course of his remarks, Mr. Evan Williams, the President of the Mining Association of Great Britain, stated that they wanted to put the Council in a position to tell every buyer of coal what was the best way of using coal and why it could be more economically used as a source of light, heat, and power than oil. At the moment the Movement was financed partly by the Mining Association and partly by the merchants and factors, but larger funds would be necessary, and in this connection he suggested the allocation to the service of the Council of a part of the levy now devoted to the Miners' Welfare Fund. Recreation grounds, pithead baths, and other amenities were very desirable, but the greatest welfare they could provide for the miner was work.

New Appointments.

On Thursday of last week Mr. D. Morgan Rees, of D. Morgan Rees and Sons, Ltd., wire rope makers and drawers, of Whitchurch, near Cardiff, was installed as President of the South Wales Institute of Engineers, in succession to Mr. D. Farr Davies, and the subject of his address to the members was the history and present practice of wire drawing. Mr. Rees, who holds a prominent position in the industrial life of South Wales, particularly in the coal mining areas, can claim the credit for initiating the Back-to-Coal Movement, which has made so much headway in this district. Another appointment is that of Major F. E. S. Beavan, manager of the Barry Graving Dock and Engineering Company, Ltd., of Barry, as President of the Bristol Channel Engineers and Ship Repairers Employers' Association, in succession to Mr. L. T. G. Soulsby, who retired after two years of office. Mr. George B. Bailey, joint managing director of C. H. Bailey, Graham and Co., Ltd., was appointed Vice-President.

Current Business.

The steam coal market displays no new feature. Sized coals show no sign of easing, as the demand for supplies of these grades is well maintained, especially those of low volatiles. The inquiry for large coals is extremely restricted, but hopes are entertained that a rather better demand from abroad will shortly be forthcoming, as it is calculated that stocks should by this time show some diminution, and that consumers abroad will be coming along for fresh supplies of steam coals. Anthracite coals keep very firm all round and prices are well upheld. Coke moves off steadily, though values show no change, while patent fuel continues steady. Pitwood supplies are rather excessive to the requirements of collieries, and the market is on the easy side at round about 20s. 6d.

CALENDARS, DIARIES, &c.

ROBERT K. BURT, 21, Farringdon-street, E.C.4.—Wall calendar.

DARIEN PRESS, 5, 6a, and 7, Bristo-place, Edinburgh.—Wall calendar.

HACKBRIDGE ELECTRIC CONSTRUCTION COMPANY, Ltd., Walton-on-Thames, Surrey.—Wall calendar.

INTERNATIONAL CONSTRUCTION COMPANY, Ltd., 56, Kingsway, W.C.2.—Wall calendar.

C. ISLER AND CO., Ltd., Bear-lane, Southwark, S.E.1.—Wall calendar.

CATALOGUES.

HOPKINSONS, Ltd., Huddersfield.—Centrifugal purifier list No. C. 3210.

BENJAMIN ELECTRIC, Ltd., Tariff-road, N.17.—List 1250 of industrial and commercial lighting fittings.

HANCOCK AND CO. (ENGINEERS), Ltd., Aurelia-road, Croydon.—Details of flame cutting and profiling machines.

RANSOMES AND RAPIER, Ltd., Ipswich.—A leaflet describing a long-stroke, tension type, hydraulic buffer stop.

RICHTER AND PICKIS, 6, Crescent, Minories, E.C.3.—Leaflets on "Ricanpick" excavators and Diesel locomotives.

WADDELLS (STRATFORD STEEL EQUIPMENT), Ltd., Hall-road, E.15.—Illustrated lists of steel equipment for stores and offices.

HEPBURN CONVEYOR COMPANY, Ltd., Wakefield.—Booklet No. 68, describing suspended conveyor mechanical handling systems.

MIRRLEES WATSON COMPANY, Ltd., Scotland-street, Glasgow.—A brochure dealing in some detail with sugar factory equipment in India.

CRESSALL MANUFACTURING COMPANY, 31 and 32, Tower-street, Birmingham.—Publication 43 on resistances and regulators for all purposes.

ENGLISH ELECTRIC COMPANY, Ltd., Queen's House, Kingsway, W.C.2.—Publication No. 70 on electric haulage and No. 69 on closed air circuit motors.

STURTEVANT ENGINEERING COMPANY, Ltd., 147, Queen Victoria-street, E.C.4.—Publication No. 1128 on heating, ventilating, and air conditioning.

BRITISH INSULATED CABLES, Ltd., Prescot, Lancs.—The following books: "Radio Materials," "Wiring Systems," "Overhead Line Materials."

SIR WM. ARROL AND CO., Ltd., Parkhead, Glasgow.—The 1932 book on "Cranes," illustrating cranes of all types and sizes supplied by the company.

W. T. HENLEY'S TELEGRAPH WORKS COMPANY, Ltd., Holborn-viaduct, E.C.1.—Particulars of the firm's compact type link disconnecting-box.

FERGUSON PAILIN, Ltd., Higher Openshaw, Manchester.—An amusing booklet presenting some varied but relevant ideas on the firm's switchgear products.

GENERAL ACCESSORIES COMPANY, Ltd., 18–22, Euston-buildings, George-street, N.W.1.—Catalogue of electrical accessories for lighting, heating, cooking, &c.

DAVY BROTHERS, Ltd., Park Ironworks, Sheffield.—Publication No. 60, giving illustrated details of plastic moulding presses of the Watson-Stillman Company's type.

BABCOCK AND WILCOX, Ltd., Babcock House, Farringdon-street, E.C.4.—A brochure illustrating a number of advertisements for recent installations of marine boilers.

FRANK WIGGLESWORTH AND CO., Ltd., Shipley, Yorks.—A number of folders on variable-speed transmission gears, couplings, pulleys, bearings, "Texrope" drives, &c.

WESTINGHOUSE BRAKE AND SAXBY SIGNAL COMPANY, Ltd., 82, York-road, N.1.—The following signal catalogue sections: Section J, Sub-section A, "D.C. Neutral Relays"; Sub-section B, "D.C. Polarised Relays." Section A, Sub-section E, "Switch Locks."

THINGS WHICH MIGHT HAVE BEEN EXPRESSED MORE TECHNICALLY.—Fourteen wheels. A view of the driving and auxiliary wheels of the French Mountain-Etat locomotive, which has no fewer than eight driving wheels coupled to the usual guiding rods. Eight tons of fuel are required to get up the necessary steam pressure.—*A sub-title in an esteemed illustrated weekly.*

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
(1) Native	15/- to 20/-
(1) Spanish	17/- to 24/-
N.E. COAST—	
Native	18/- to 21/-
Foreign (c.i.f.)	15/3

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	3 6 0	—
No. 1 Foundry	3 10 0	—
No. 3 Foundry	3 7 6	—
N.E. COAST—		
Hematite Mixed Nos.	2 19 0	2 19 0
No. 1	2 19 6	2 19 6
(f) Cleveland—		
No. 1	3 5 0	3 1 0
Siliceous Iron	3 5 0	3 1 0
No. 3 G.M.B.	3 2 6	2 18 6
No. 4 Foundry	3 1 6	2 17 6
No. 4 Forge	3 1 0	2 17 0
Mottled	3 0 6	2 16 6
White	3 0 6	2 16 6
MIDLANDS—		
(c) Staffs.— (Delivered to Station.)		
All-mine (Cold-blast)	—	—
North Staffs. Forge	3 1 0	—
„ „ Foundry	3 6 0	—
(e) Northampton—		
Foundry No. 3	3 2 6	—
Forge	2 17 6	—
(c) Derbyshire—		
No. 3 Foundry	3 6 0	—
Forge	3 1 0	—
(3) Lincolnshire—		
No. 3 Foundry	—	—
No. 4 Forge	—	—
Basic	—	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	3 15 6 (a); 4 0 6 (b); 4 5 6 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	9 15 0	9 5 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 5 0	—
Common Bars	9 5 0	—
Best Bars	10 5 0	—
Double Best Bars	10 15 0	—
Treble Best Bars	11 5 0	—
LANCS.—		
Crown Bars	9 15 0	—
Best Bars	10 5 0	—
Hoops	12 0 0	—
S. YORKS.—		
Crown Bars	9 15 0	—
Best Bars	10 15 0	—
Hoops	12 0 0	—
MIDLANDS—		
Crown Bars	8 12 6 to 9 5 0	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	8 0 0 to 8 10 0	—
Gas Tube Strip	10 7 6 to 10 10 0	—

STEEL. (d)

	(5) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates (Marine)	9 0 0	8 10 0
„ „ (Land)	—	—
Ship Plates, ¾in. and up	8 15 0	7 15 0
Sections	8 7 6	7 7 6
Steel Sheets, ¼in.	7 15 0	7 15 0
Sheets (Gal. Cor. 24 B.G.)	11 5 0–10 Ton Lots and Upwards Delivered Glasgow Stations.	10 0 0
„ (Gal. Cor. 24 B.G.)	For Canada	10 15 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 15 0	7 15 0
Angles	8 7 6	7 7 6
Boiler Plates (Marine)	10 10 0	—
„ „ (Land)	10 0 0	—
Joists	8 15 0	7 7 6
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	7 2 6	—
Soft Billets	5 10 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	—
Billets	6 10 0 to 9 0 0	—
MANCHESTER—		
Bars (Round)	9 7 6	—
„ (Small Round)	6 15 0	—
Hoops (Baling)	10 0 0	9 15 0
„ (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
„ (Lancs. Boiler)	8 10 0	—
SHEFFIELD—		
Siemens Acid Billets	9 2 6 (basis)	—
Hard Basic	8 2 6 and 8 12 6	—
Intermediate Basic	6 12 6 and 7 2 6	—
Soft Basic	5 15 0	—
Hoops	9 10 0 to 9 15 0	—
Soft Wire Rods	7 10 0	—
MIDLANDS—		
Small Rolled Bars (all British)	7 0 0 to 7 5 0	—
Small Re-rolled Bars	6 15 0 to 6 17 6	—
Billets and Sheet Bars	4 17 6 to 5 7 6	—
Galv. Sheets	11 15 0 to 13 15 0	10 10 0
(2) Staffordshire Hoops	9 10 0	—
(d) Angles	8 7 6	—
(d) Joists	8 15 0	—
(d) Tees	9 7 6	—
(d) Bridge and Tank Plates	8 17 6	—
Boiler Plates	8 5 0 to 8 7 6	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14 f.o.b.	15/9 to 16/-
Block Tin (cash)	145 12 6
„ (three months)	146 2 6
Copper (cash)	28 11 3
„ (three months)	28 16 3
Spanish Lead (cash)	10 10 0
„ „ (three months)	10 18 9
Spelter (cash)	14 6 3
„ (three months)	14 10 0
MANCHESTER—	
Copper, Best Selected Ingots	33 0 0
„ Electrolytic	34 0 0
„ Strong Sheets	65 0 0
„ Tubes (Basis Price), lb.	0 0 10
Brass Tubes (Basis Price), lb.	0 0 9
„ Condenser, lb.	0 0 11¼
Lead, English	12 10 0
„ Foreign	11 2 6
Spelter	14 15 6
Aluminium (per ton—raw ingot)	£95

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/10½ per lb.	
Ferro Tungsten	1/7½ per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£25 15 0	8/-
„ „ 6 p.c. to 8 p.c.	£24 10 0	7/6
„ „ 8 p.c. to 10 p.c.	£22 5 0	7/-
„ „ Specially Refined		
„ „ Max. 2 p.c. carbon	£36 10 0	11/-
„ „ „ 1 p.c. carbon	£42 12 0	14/-
„ „ „ 0·70 p.c. carbon	£44 0 0	16/-
„ „ „ carbon free	1/- per lb.	
Metallic Chromium	2/9 per lb.	
Ferro Manganese (per ton)	£10 15 0 for home	
„ „ „	£9 15 0 for export	
„ Silicon, 45 p.c. to 50 p.c.	£13 10 0 scale 5/- per unit	
„ „ 75 p.c.	£19 10 0 scale 6/- per unit	
„ Vanadium	12/6 per lb.	
„ Molybdenum	6/3 per lb.	
„ Titanium (carbon free)	9d. per lb.	
Nickel (per ton)	£245 0 0	
Ferro Cobalt	7/9 per lb.	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	15/6
„ „ Ell	16/- to 16/6
„ „ Splint	16/- to 17/6
„ „ Trebles	15/-
„ „ Doubles	12/6
„ „ Singles	11/-
AYRSHIRE—	
(f.o.b. Ports)—Steam	14/6
„ „ Jewel	16/6
„ „ Trebles	15/6
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	13/- to 15/-
Screened Navigation	16/6 to 17/6
Trebles	15/6 to 16/-
Doubles	12/6 to 14/-
Singles	10/9 to 11/-
LOTHIANS—	
(f.o.b. Leith)—Best Steam	13/6 to 14/-
Secondary Steam	13/6
Trebles	15/6
Doubles	12/-
Singles	11/- to 11/3

(8) N.W. COAST— ENGLAND.

Steams	19/- to 23/6
Household	32/6 to 52/6
Coke	18/- to 21/-
NORTHUMBERLAND—	
Best Steams	14/6
Second Steams	12/6 to 12/9
Steam Smalls	8/6
Unscreened	12/6 to 13/-
Household	27/- to 39/-
DURHAM—	
Best Gas	14/6
Second	13/3 to 13/6
Household	25/- to 37/-
Foundry Coke	24/-

SHEFFIELD	Inland.	
Best Hand-picked Branch	27/- to 28/-	—
South Yorkshire Best	23/- to 24/-	—
South Yorkshire Seconds	18/- to 21/-	—
Derbyshire Best House	22/- to 23/6	—
Derbyshire Best Brights	18/- to 20/-	—
Screened Seconds	17/6 to 19/-	—
Kitchen Coal	16/6 to 17/6	—
Best Screened Nuts	17/- to 18/6	—
Small Screened Nuts	16/- to 16/6	—
Yorkshire Hards	17/- to 18/-	—
Derbyshire Hards	17/- to 18/-	—
Rough Slacks	8/6 to 9/6	—
Nutty Slacks	7/- to 8/6	—

Blast-furnace Coke (Inland) 10/- on rail at ovens

Furnace and Foundry Coke (Export), f.o.b., 14/6 to 15/6

(9) SOUTH WALES.

CARDIFF—

Steam Coals :	
Best Smokeless Large	19/6 to 19/9
Second Smokeless Large	18/9 to 19/6
Best Dry Large	19/- to 19/6
Ordinary Dry Large	17/9 to 18/3
Best Black Vein Large	18/3 to 18/6
Western Valley Large	17/9 to 18/-
Best Eastern Valley Large	17/7½ to 17/9
Ordinary Eastern Valley Large	17/3 to 17/6
Best Steam Smalls	13/- to 13/6
Ordinary Smalls	11/- to 13/-
Washed Nuts	20/- to 32/-
No. 3 Rhondda Large	19/6 to 19/9
„ „ Smalls	15/- to 16/-
No. 2 „ Large	17/- to 17/3
„ „ Through	15/6 to 16/-
„ „ Smalls	14/- to 14/3
Foundry Coke (Export)	22/6 to 36/6
Furnace Coke (Export)	15/6 to 16/6
Patent Fuel	22/-
Pitwood (ex ship)	20/6 to 21/6

SWANSEA—

Anthracite Coals :	
Best Big Vein Large	36/- to 38/6
Seconds	27/- to 34/-
Red Vein	22/- to 26/6
Machine-made Cobbles	36/6 to 48/6
Nuts	36/6 to 48/6
Beans	28/6 to 32/6
Peas	19/- to 20/-
Breaker Duff	8/6 to 9/-
Rubbly Culm	8/6 to 9/-
Steam Coals :	
Large	20/- to 20/6
Seconds	18/- to 20/-
Smalls	11/6 to 13/-
Cargo Through	16/- to 17/6

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham. (d) Rebate: Joists (minimum), 22/6; Ordinary Ship, Bridge, and Tank Plates and Sections, 15/-, if home consumers confine purchases from associated British Steel Makers. (e) Delivered Black Country Stations. (f) Delivered North-East Coast.

French Engineering Notes.

(From our own Correspondent in Paris.)

South American Air Service.

THE flight of the aeroplane "Arc-en-Ciel" from Port-Louis to Natal in Brazil is the first definite result of the efforts being made to ensure a postal service between France and South America without the use of the naval scouts which have had to be employed to carry mails across the South Atlantic. As arrangements are being made to inaugurate a regular German airship service to South America this year the French could lose no time in fulfilling the obligations imposed upon them by postal conventions to organise a complete air line. The attempts to do this by means of commercial seaplanes have so far failed on account of the weight of the machines and the difficulty of alighting safely on the seas and taking off again. There exist experimental types of seaplane which have been undergoing trials for months past, and until they are proved to be capable of being used for commercial services the French seek to demonstrate the possibility of employing aeroplanes for the purpose. The "Arc-en-Ciel" crossed the 2000 miles of ocean in 14 h. 27 min. It carried two pilots, a navigator, a wireless operator and mechanic. The machine is constructed of wood and the cabins in the fuselage are of rectangular section. The engines on each side are built into the plane and have gangways to them. The three Hispano-Suiza engines are each of 650 horse-power at 2400 revolutions per minute, and are geared down to the propeller shafts. The fuel is carried in eleven tanks inside the plane. The total length of the machine is 16 m. and the width across the plane 30 m. Its weight without fuel is 7½ tons, and at the start the total weight with fuel and load was 14½ tons. The machine is designed and built to float in case of forced descent on the sea, and with the wireless equipment to indicate its position there is, it is claimed, little danger for the crew and passengers. In a word, it is sought to show that the aeroplane can be used for commercial ocean flights with no more risk on the water than in the case of seaplanes. Now that there is a probability of Europe and South America being linked up with aeroplanes and airships during the year, it may be possible to obtain comparative data showing the probable development of ocean air services in the future.

Wage Reductions.

Rates of wages have been established on a relatively high scale in this country, because, in normal times, there has always been a shortage of labour, and during the boom at the beginning of the past decade an importation of labour had to be organised to make up for the deficiency. The French flocked into the "specialised labour" ranks in works and factories, and foreigners had to be employed for other occupations, as well as for skilled work in engineering shops. An increase in the cost of living complicated the situation, which many employers met by granting bonuses that were intended to be of a temporary character, but as the cost of commodities is still high it has been difficult to suppress the system, and these bonuses constitute an appreciable addition to the wages paid. Now that industry is in the throes of a crisis the problem of wages reduction has become acute. Not only do employers find it imperative to adapt wages to present conditions if they are to keep works running, but they argue that the rates are higher than those in most other countries, and they must have some relief to enable them to meet the increasing foreign competition. An example of the difficulties now confronting manufacturers is provided at Armentières, where the weavers have gone out on strike against a decision of the employers to suppress the bonus and to require the men to work more looms. There is the usual controversy over the effect which the more looms per weaver system may have in aggravating unemployment. The world competition, particularly from the Far East, has made it inevitable, and employers state that a larger individual production, and a relatively much larger total output resulting from a successful bid for competitive business, will give employment to everybody. The long struggle of dockers against wage reductions has ended in their accepting the new terms offered. The forty hours' week is entirely condemned by employers, who regard it as impracticable, and they have no illusion over the determination of the men to make no sacrifice of the weekly wage they now receive, so that the shorter week would upset the industrial organisation and increase wages. To the general surprise, the Government has accepted the principle of the forty hours' week, but there appears to be very little chance of its being adopted in this country.

A New Liner.

On Sunday last there was launched from the Ciotat yard of the Société Provençale de Constructions Navales, the 14,835-ton liner "President Doumer," of the Messageries Maritimes, which will be put on the Oriental service. It will be propelled by two airless injection oil engines of 8600 horse-power. The fire-fighting equipment will be made as complete as possible, and special precautions will be taken against risk of fire from oil vapour. The ceremony of launching was presided over by the Minister of the Merchant Marine, who has affirmed that no time will be lost in building another ship to replace the "Atlantique" for the South American service.

The Year's Trade.

The attempt to adjust an adverse balance of trade, and protect home industries by means of import quotas and other restrictions, had the effect of reducing the value of imports during 1932 by nearly 30 per cent., as compared with the previous year. At the same time, exports contracted to the extent of more than 35 per cent. The imports fell from 42,205 million francs in 1931 to 29,825 millions last year, the decline being more particularly notable in raw materials and manufactured goods. The restricted imports of coal were largely responsible for the decrease. The exports last year were valued at 19,693 million francs, as against 30,435 millions in 1931. The percentage decrease was greater in the exports of manufactured goods than in those of raw material and other products.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

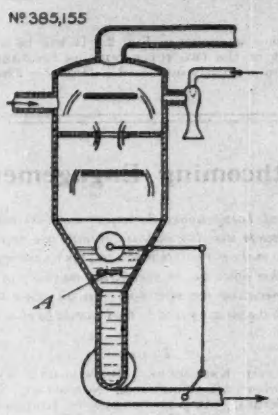
The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

CONDENSERS AND FEED-WATER HEATERS.

385,155. March 23rd, 1932.—FEED WATER HEATERS, A.G. Brown, Boveri et Cie, Baden, Switzerland.

In feed water heaters heated by steam bled off from a turbine it may happen that the pressure in the heater is suddenly

Nº 385,155



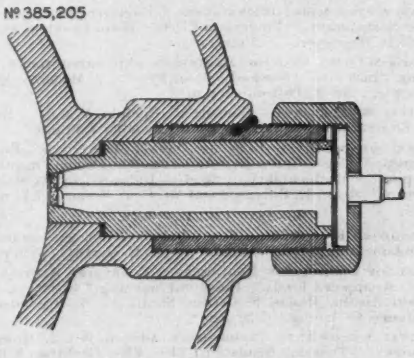
reduced through the turbine losing its load. In such circumstances, the water in the heater may flash into steam and cause violent bumping to the detriment of the lighter parts of the heater. The inventors consequently introduce baffles, such as that at A, to break up the flow of water.—*December 22nd*, 1932.

INTERNAL COMBUSTION ENGINES.

385,205. May 24th, 1932.—FUEL INJECTION NOZZLES, "Fusion-Moteurs," Boulevard Galliéni, Rueil-Malmaison (Seine-et-Oise), France.

In this nozzle an effort is made to produce a jet which can be made with a high degree of accuracy on an economical basis,

Nº 385,205

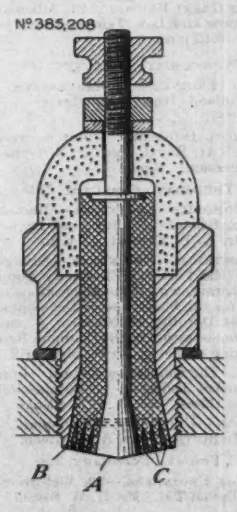


and which can be polished throughout. The core of the jet is made in two pieces, like the halves of a lead pencil, and the oil duct is polished thoroughly. The orifice is produced by grinding away the pieces indicated by the dotted shading. Other styles of orifice are suggested in the specification.—*December 22nd*, 1932.

385,208. May 31st, 1932.—SPARKING PLUGS, *F. Watson*, 43, *Southampton-buildings, London, W.C.2.*

With this plug the spark jumps from the central electrode A to the earthed casing B, but *en route* passes the auxiliary

Nº 385,208



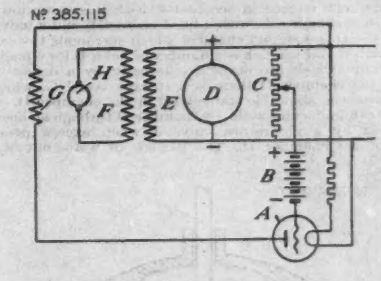
electrodes C. One of the essential features is that the end of the plug should present a convex face, which is said to prevent the deposition of soot and oil.—*December 22nd*, 1932.

DYNAMOS AND MOTORS.

385,115. December 28th, 1931.—ELECTRIC GENERATING PLANTS, N. V. Philips' Gloeilampenfabrieken, Emmasingel 13 D, Eindhoven, Province of North-Brabant, the Netherlands.

This invention concerns electric generative apparatus and particularly lighting installations for vehicles. The object is to provide a system in which the voltage of the generator may be kept constant in a simple manner, in spite of large variations of the speed. The grid of a three-electrode valve is connected through a battery B to the slide contact of a potentiometer C connected to the terminals of a generator D having a main exciting winding E, and an auxiliary winding F. The battery

Nº 385,115

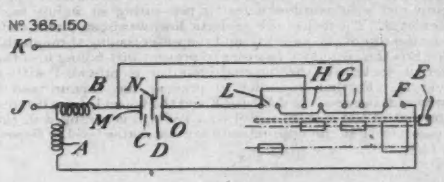


voltage slightly exceeds the tension of the potentiometer set up at the grid and counteracts the latter so that the grid is negative with respect to the cathode. With an increasing generator voltage the grid voltage increases in absolute value, and this results in an increase of the anode current traversing the exciting winding G of the auxiliary dynamo H. Consequently, the tension of the auxiliary dynamo increases and the number of counteracting ampere turns of the auxiliary exciting winding G increases so that the variations of the generator voltage are counteracted. The cathode is also connected through a resistance to the terminals of the generator D, and with this coupling arrangement the discharge tube works at the same time as a diode.—*December 22nd*, 1932.

385,150. March 17th, 1932.—SINGLE-PHASE INDUCTION MOTORS, the English Electric Company, Ltd., of Queen's House, 28, Kingsway, London, W.C.2; Reginald Donahoe Ball, and Leslie Roberts, both of Phœnix Works, Bradford, Yorkshire.

The type of single-phase induction motor dealt with in this specification is a capacitor motor, having a two-phase wound stator and employing one or a number of condensers in series with one of the phase windings for producing the necessary difference of phase at starting. A is the running and B the starting winding of the motor stator. The capacitors are shown at C and D. To start the motor the handle E is moved so as to close the switches F, G, H. Current then flows

Nº 385,150



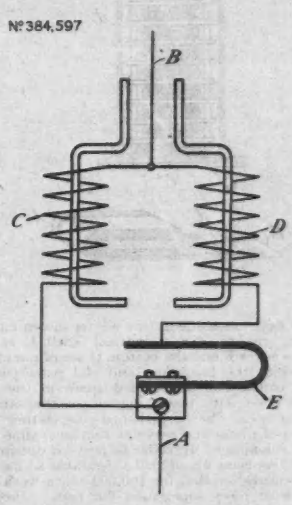
from the line J through the winding A and switch F to the line K. Current also passes through the winding B and then divides, part flowing through the switch G and capacitor D to the switch H, and part flowing in parallel through capacitor C to the switch H, and thence to the line K. Further movement of the handle leaves switch F closed, but opens switches G and H, and closes switch L. Current now flows from J through winding B, capacitors C and D, in series, and switch L to the main K. The circuit through winding A and switch F remains unaltered. The capacities C and D are between the plates M and N and the plates N and O respectively. The rotor winding is not shown, but may be of the squirrel-cage type.—*December 22nd*, 1932.

SWITCHGEAR.

384,597. July 1st, 1932.—OVERLOAD ELECTRIC SWITCHES, Wilhelm Leyhausen, of 79, Bucherstrasse, Nürnberg, Germany.

With small electro-magnetic overload switches the winding of the magnet coils presents difficulties when heavy-gauge wire has to be used for high current densities, particularly when flat coils with cores of rectangular section are employed. For this

Nº 384,597

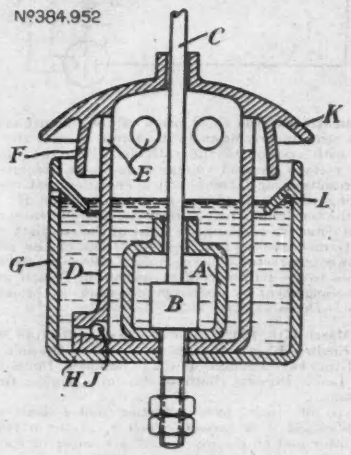


reason the parts of the magnet winding are frequently connected in parallel in order to reduce the section of the wire by one-half. The thermal overload device on such switches is, however, traversed by the whole current and it consequently develops considerable heat, which acts unfavourably on the magnet coils and contacts. The trouble is increased when the thermostat is directly traversed and heated by the currents. According to the invention the thermostat or its heating winding

is connected in series with only a part of the subdivided magnet winding. The cross section of the heating winding or of the bi-metallic strip is thereby reduced by one-half, so that for a 20-ampère switch the winding and bi-metallic strip of a 10-ampère switch may be adopted. The current entering at A flows on the one hand through the magnet coil C and on the other hand through the thermostat E and the magnet coil D to B. If more or fewer windings are given to one of the magnet coils the thermostat can be exactly adjusted to the current density desired. This could also be attained in a more complicated manner by employing coils wound with different gauges of wire. —*December 8th*, 1932.

384,952. August 10th, 1932.—ELECTRIC SWITCHES OF THE EXPLOSION-POT TYPE, *International General Electric Company, Inc., of 120, Broadway, New York, U.S.A.*

A switch constructed in accordance with this invention has an explosion chamber A, with a fixed contact B and a movable contact C. D is a second chamber which surrounds the explosion chamber, and which has a number of holes E for equalising the pressure which are covered externally by a deflector F. Around the chamber D there is a storage vessel G, which is higher than the allowable water level in the chamber D. The vessel G communicates with the chamber D through an opening H, closed by a non-return valve J when excess pressure occurs in the chamber D. The passage of water out of the

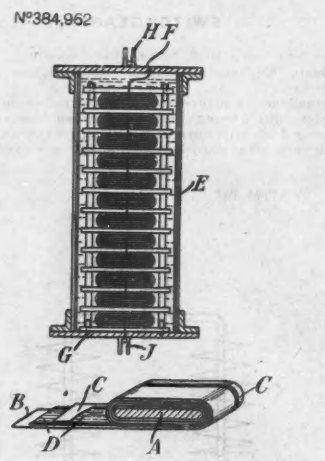


chamber D into the storage vessel G is thus prevented during the switching off operation, whilst the water can pass freely from G into D, when the switch is in the normal position. The vessel G forms a water level indicator for the chamber D, and is provided with overflow holes for preventing an unduly high water level. The deflector F projects downwards, so that it ends below the top of the vessel G, and the water issuing through the holes E is thus caught. In order to prevent dirt falling into the external container, the internal chamber is provided with a shield K. Further, in order to prevent the vapour issuing downwards between the deflector F and the vessel D from driving water out of the storage vessel G, a baffle L is arranged in the storage vessel at the approximate normal water level.—*December 15th*, 1932.

MISCELLANEOUS.

384,962. August 22nd, 1932.—ELECTRIC CONDENSERS, Meirowsky and Co. Aktiengesellschaft, of Porz am Rhein, Germany.

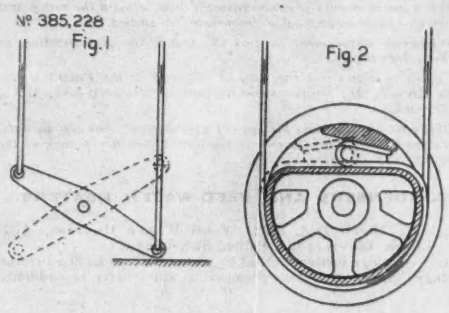
This invention relates to the forming of the condenser in such a manner that the highest voltages can be dealt with by a condenser occupying a relatively small space. The lower illustration shows how the condenser elements are made on a flat core A on which two metal foils B and C, and oil-saturated paper layer D are wound. The metal foil B projects at one side and the metal foil C on the other side beyond the oil-saturated paper strip. Each separate coil is saturated with insulating oil, preferably with the application of heat and vacuum. A column



of superposed flat coils made in this way is shown mounted in a casing, which consists of a cylindrical shell E of insulating material. The cover F and the bottom G are of metal connected by conductors to the beginning and end respectively of the series of flat coils. The unoccupied space in the interior of the casing is filled with insulating oil, of the same kind as the saturating oil. The fork-shaped suspending devices H and J are also of metal and serve at the same time as the terminals of the condenser. In order to prevent detrimental glow discharges, it has been found to be desirable to subdivide the condenser elements, so that for 100,000 volts working voltage there are at least forty superposed flat coils.—*December 15th*, 1932.

385,228. July 6th, 1932.—DREDGER AND CRANE ROPES, Orenstein und Koppel Aktiengesellschaft, Tempelhofer Ufer 23-24, Berlin, S.W.

With grabs worked by means of four ropes it is necessary to equalise the tension in the several parts of the rope, regardless of how it is wound on the drums, but it has been found that the usual arrangement of an equalising beam, as shown in Fig. 1, is not always adequate, as the difference in the take-up between the two parts may be so great that the beam turns to such an angle that the two parts of the rope are brought dangerously close together. As a consequence, the inventors employ,



instead, a pulley as shown in Fig. 2. It will be seen that the distance apart of the two ropes remains constant, while the accommodation is greatly increased.—*December 22nd*, 1932.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Monday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

INST. OF CIVIL ENGINEERS: BIRMINGHAM AND DISTRICT ASSOC.—Chamber of Commerce, New-street, Birmingham. Institution lecture, "Impact Stresses in Bridges—Retrospect and Present-day Aspect," Mr. Conrad Gribble. 6 p.m.

INST. OF ELECTRICAL ENGINEERS.—Grand Hotel, Harrogate. Dinner and dance. 8 p.m.–2 a.m.

INST. OF ELECTRICAL ENGINEERS: N.E. STUDENTS.—Armstrong College, Newcastle-upon-Tyne. Students' lecture, 1933, "Oil-filled Cables," Mr. R. E. G. Horley. 7.15 p.m.

INST. OF MECHANICAL ENGINEERS.—Storey's-gate, S.W.1.—"Handling and Storing of Grain, with Special Reference to Canadian Methods," Mr. H. H. Broughton. 6 p.m.

INSTITUTIONS OF ELECTRICAL, AND MECHANICAL ENGINEERS: GRADUATES AND STUDENTS: AND LONDON STUDENTS OF CIVIL ENGINEERING.—Victoria Halls, Southampton-row, W.C. 1. Dance. 7.30 p.m.

JUNIOR INST. OF ENGINEERS.—39, Victoria-street, S.W.1. "Some Experiments on Reinforced Concrete Slabs," Mr. R. H. Squire. 7.30 p.m.

MANCHESTER ASSOC. OF ENGINEERS.—Engineers' Club, Albert-square, Manchester. "Progress in Electric Motor Development," Mr. H. D. Hoseason. 7.15 p.m.

N.-EAST COAST INST. OF ENGINEERS AND SHIPBUILDERS.—Mining Institute, Newcastle-upon-Tyne. "Modern Ship Repairing," Mr. J. Patton. 6 p.m.

ROYAL SOC. OF ARTS.—John-street, Adelphi, W.C.2. "Railway Electrification in India," Mr. F. Lydall. 4.30 p.m.

WEST OF SCOTLAND IRON AND STEEL INSTITUTE.—Royal Technical College, George-street, Glasgow. Council meeting, 6.45 p.m. "Machinability of Steel as Indicated by its Macro-structure," Mr. F. E. Robinson and Mr. C. T. Nesbitt. 7.15 p.m.

MONDAY, JANUARY 30TH.

BRADFORD ENGINEERING SOC.—Technical College, Bradford. "Fundamentals of Gear Design," Dr. H. E. Merritt. 7.30 p.m.

INST. OF PRODUCTION ENGINEERS: YORKSHIRE SECTION.—Hotel Metropole, Leeds. Inaugural meeting. Speakers, Sir Herbert Austin, Messrs. S. Carlton Smith, R. H. Hutchinson, and James G. Young. 7.30 p.m.

ROYAL SOC. OF ARTS.—John-street, Adelphi, W.C.2. Howard Lectures. "Thermal Insulation," Dr. Ezer Griffiths, F.R.S. 8 p.m.

TUESDAY, JANUARY 31ST.

INST. OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND.—39, Elmbank-crescent, Glasgow, C.2. "Propulsive Efficiency and Seaworthiness of a Ship in Smooth and Rough Waters," Mr. J. L. Kent. 7.30 p.m.

INST. OF MARINE ENGINEERS.—The Minories, E.C.3. "Pulverised Coal Firing in Marine Scotch Boilers," Messrs. W. G. Gibbons and M. Arthurson. 6 p.m.

SHEFFIELD METALLURGICAL ASSOCIATION.—190, West-street, Sheffield. "Manufacture of the Mammoth Cunarder Castings," Mr. F. Swift. 7.30 p.m.

ROYAL INST. OF GREAT BRITAIN.—21, Albemarle-street, W.1. "Low Temperatures and Low Temperature Phenomena," Mr. J. C. M'Lennan. 5.15 p.m.

WEDNESDAY, FEBRUARY 1ST.

INST. OF CIVIL ENGINEERS: MANCHESTER AND DISTRICT ASSOCIATION.—Midland Hotel, Manchester. Annual dinner. 6.30 for 7 p.m.

SOC. OF CHEMICAL INDUSTRY.—Joint meeting with Soc. of Public Analysts. At Royal Soc. of Medicine, 1, Wimpole-street, W.1. Discussion. 8 p.m.

THURSDAY, FEBRUARY 2ND.

INST. OF AUTOMOBILE ENGINEERS.—Merchant Venturers' Technical College, Bristol. "Alloy Cast Irons in Automobile Construction," Dr. A. B. Everest. 7 p.m.

INST. OF ELECTRICAL ENGINEERS.—Savoy-place, W.C.2. "An Analysis of the Costs of Electricity Supply and Distribution in Great Britain, with some Suggestions as to the Causes of and Remedies for the Slow Rate of Development," Mr. J. M. Kennedy and Miss Dorothy M. Noakes. 6 p.m. Preceded at 5.30 p.m. by a demonstration in the Common Room by Mr. D. J. Bolton of a working model of a two-part tariff indicator.

INST. OF FUEL.—The University, Bristol. Joint meeting with the Soc. of Chemical Industry. "Elimination of Dust and Sulphur from Flue Gases," Mr. H. E. Wallsom. 7.30 p.m.

INST. OF METALS.—University, Birmingham. "Refractories in Metallurgical Industries," Mr. A. T. Green. 7 p.m.

FRIDAY, FEBRUARY 3RD.

JUNIOR INST. OF ENGINEERS.—39, Victoria-street, S.W.1.—"Dredging for Alluvial Tin," Mr. H. W. Sewell. 7.30 p.m.

N.E. COAST INST. OF ENGINEERS AND SHIPBUILDERS.—Meeting cancelled.

ROYAL INST. OF GREAT BRITAIN.—21, Albemarle-street, W.1. Discourse, Mr. Cyril Norwood. 9 p.m.

SOUTHERN RAILWAY PUPILS' AND PREMIUM APPRENTICES' ASSOCIATION.—Charing Cross Hotel, W.C.2. Annual dinner. Tickets may be obtained from Mr. E. Forge, 159, Desborough-road, Eastleigh.

SATURDAY, FEBRUARY 4TH.

INST. OF BRITISH FOUNDRYMEN: LANCASHIRE.—Grand Hotel, Manchester. Annual Whist Drive, Dinner and Dance. 4 p.m. to Midnight.

INST. OF CIVIL ENGINEERS.—Students' visit to National Physical Laboratory, Teddington.

STAFFORDSHIRE IRON AND STEEL INST.—Dudley Arms Hotel, Dudley. Annual dinner. 6.30 p.m.

MONDAY, FEBRUARY 6TH.

BRADFORD ENGINEERING SOC.—Technical College, Bradford. "Behaviour of Engineering Materials at High Temperatures," Mr. R. G. Batson. 7.30 p.m.

ENGINEERS' GERMAN CIRCLE.—At Inst. of Mechanical Engineers, Storey's-gate, S.W.1. "A Review of Iron and Steel Manufacture," Herr Victor B. Reichwald. 6 p.m.

ROYAL SOC. OF ARTS.—John-street, Adelphi, W.C.2. Howard Lecture, "Thermal Insulation," Dr. Ezer Griffiths, F.R.S. 8 p.m.

SOC. OF ENGINEERS.—At Geological Society, Burlington House, W.1. Presentation of premiums awarded, 1932. Presidential address, Mr. J. D. Haworth. 6 p.m.

WOLVERHAMPTON AND DISTRICT ENGINEERING SOC.—Victoria Hotel, Wolverhampton. Debate, "Boiler and Furnace Firing." 7.30 p.m.

TUESDAY, FEBRUARY 7TH.

BRADFORD EDUCATION COMMITTEE.—Technical College, Bradford. "Design of Welded Structures," Mr. C. Helsby. 7.30 p.m.

DIESEL ENGINE USERS ASSOCIATION.—Coventry Restaurant, Wardour-street, W.1. Annual dinner. 7 for 7.30 p.m.

UNIVERSITY OF LONDON, KING'S COLLEGE, W.C.2.—Department of Electrical Engineering. "The Theory of the Induction Motor," Dr. F. T. Chapman. 5.30 p.m.

WEDNESDAY, FEBRUARY 8TH.

INST. OF METALS: LONDON LOCAL SECTION.—Joint meeting with the Food Group of Soc. of Chemical Industry. Burlington House, W.1. Discussion, "Non-ferrous Metals in the Food Industry." 8 p.m.

ROYAL SOC. OF ARTS.—John-street, Adelphi, W.C.2. "Design and Form as Applied to the Manufacture of Glassware," Mr. J. H. Hogan. 8 p.m.

SOC. OF GLASS TECHNOLOGY: LONDON SECTION.—At Holophane, Ltd., Elverton-street, S.W.1. "Glass Industry on the Continent," Professor W. E. S. Turner. 7.30 p.m.

FRIDAY, FEBRUARY 10TH.

INST. OF METALS.—The University, Sheffield. "Soft Solders and Fluxes," Dr. O. F. Hudson. 7.30 p.m.

JUNIOR INST. OF ENGINEERS.—39, Victoria-street, S.W.1. "Oil from Coal," Dr. C. H. Lander. 7.30 p.m.

N.E. COAST INST. OF ENGINEERS AND SHIPBUILDERS.—Bolbec Hall, Newcastle-upon-Tyne. "Destroyer Forms," Mr. J. L. Scott. "Approximating E.H.P.: Notes of Amendments to Data Given in 1927 Paper," Mr. A. L. Ayre.

SHEFFIELD METALLURGICAL ASSOCIATION.—Royal Victoria Hotel, Sheffield. Supper-dance. 7.30 p.m. to 1 a.m.

MONDAY, FEBRUARY 13TH.

INST. OF METALS.—At 39, Elmbank-crescent, Glasgow. "Modern Light Alloys, with Particular Reference to Corrosion," Dr. Leslie Aitchison. 7.30 p.m.

TUESDAY, FEBRUARY 14TH.

INST. OF METALS.—Armstrong College, Newcastle-upon-Tyne. "Refractory Materials and the Non-ferrous Industries," Mr. A. B. Searle. 7.30 p.m.

INST. OF METALS.—Y.M.C.A., Swansea. "Platinum Metals," Mr. R. H. Atkinson. 6.15 p.m.

UNIVERSITY OF LONDON, KING'S COLLEGE, W.C.2.—Department of Electrical Engineering. "The Theory of the Induction Motor," Dr. F. T. Chapman. 5.30 p.m.

THURSDAY, FEBRUARY 16TH.

INST. OF ELECTRICAL ENGINEERS.—Grosvenor House, Park-lane, W.1. Annual dinner and reunion. 7 p.m. for 7.30 p.m.

INST. OF STRUCTURAL ENGINEERS.—Hotel Metropole, Leeds. "Some Notes on Floor Construction," Mr. E. S. Andrews. 7 p.m.

FRIDAY, FEBRUARY 17TH.

RAILWAY CLUB.—57, Fetter-lane, E.C.4. Annual general meeting. Presidential address. 7.30 p.m.

INST. OF CHEMICAL ENGINEERS.—Hotel Victoria, Northumberland-avenue, W.C.2. Eleventh annual meeting and annual dinner. Annual meeting, 11 a.m. Presidential address, "Chemical Engineering and the Soap Industry," the Rt. Hon. the Viscount Leverhulme, 11.45 a.m. Luncheon, 12.45 p.m. "Metallurgy from the Standpoint of the Chemical Engineer," Mr. L. Singlehurst-Ward, 2.15 p.m. King Edward VII. Rooms, annual dinner, 7 for 7.30 p.m.

MANCHESTER ASSOC. OF ENGINEERS.—Engineers' Club, 17, Albert-square, Manchester. Annual dinner. 6.45 p.m. for 7.15 p.m.

MONDAY, FEBRUARY 20TH.

ENGINEERS' GERMAN CIRCLE.—At Inst. of Mechanical Engineers, Storey's-gate, S.W.1. "New Developments in the Design of Rolling Mill Equipment," Herr Dip.-Ingenieur Ernst Kuge. 6 p.m.

WOLVERHAMPTON AND DISTRICT ENGINEERING SOC.—Victoria Hotel, Wolverhampton. "Modern Developments in Brid. Building," Mr. F. H. Abrahams. 7.30 p.m.

TUESDAY, FEBRUARY 21ST.

OLD CENTRALIANS.—Devereux Restaurant, Devereux-court, W.C.2. Luncheon. 1 p.m.

UNIVERSITY OF LONDON, KING'S COLLEGE, W.C.2.—Department of Electrical Engineering. "The Theory of the Induction Motor," Dr. F. T. Chapman. 5.30 p.m.

FRIDAY, MARCH 17TH.

INST. OF STRUCTURAL ENGINEERS.—Mayfair Hotel, W. 1. Annual dinner.

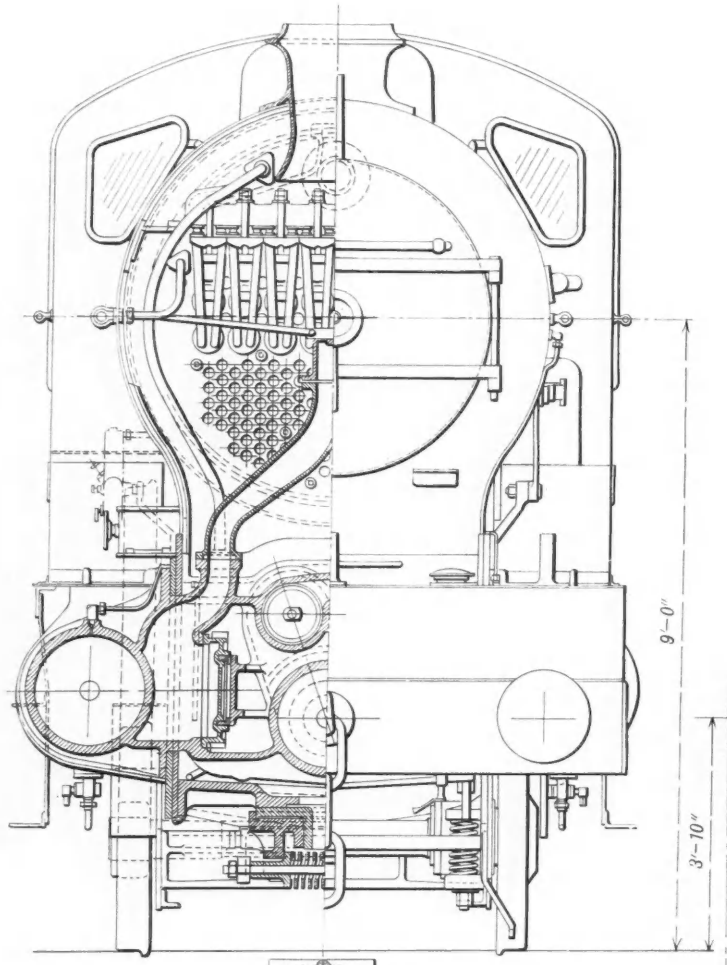
MONDAY, APRIL 3RD.

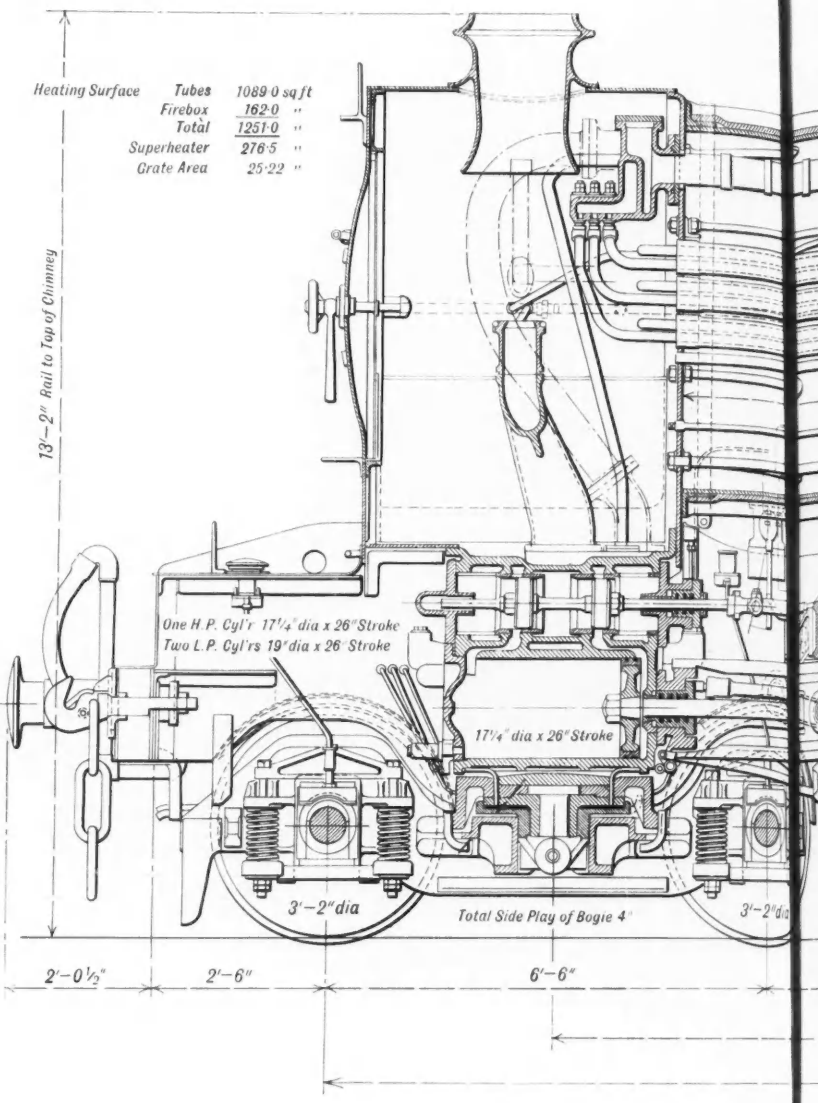
BRADFORD EDUCATION COMMITTEE.—Technical College, Bradford. "Lead Burning and Copper and Iron Welding for Plumbers and Heating Engineers," Mr. E. B. Partington. 7.30 p.m.

NEW BRITISH DESTROYER.—H.M.S. "Decoy" was handed over to the Navy at Southampton on January 17th by her builders, John I. Thornycroft and Co., Ltd. She was launched in June last, and is one of the "Acasta" class of destroyers being built under the 1930–31 Naval Estimates to the standard Admiralty design. She has a length of 315ft., a displacement of approximately 1390 tons, and 36,000 H.P. for a speed of 36 knots.

GREAT NORTHERN RAILWAY (IRELAND)—THR..CY

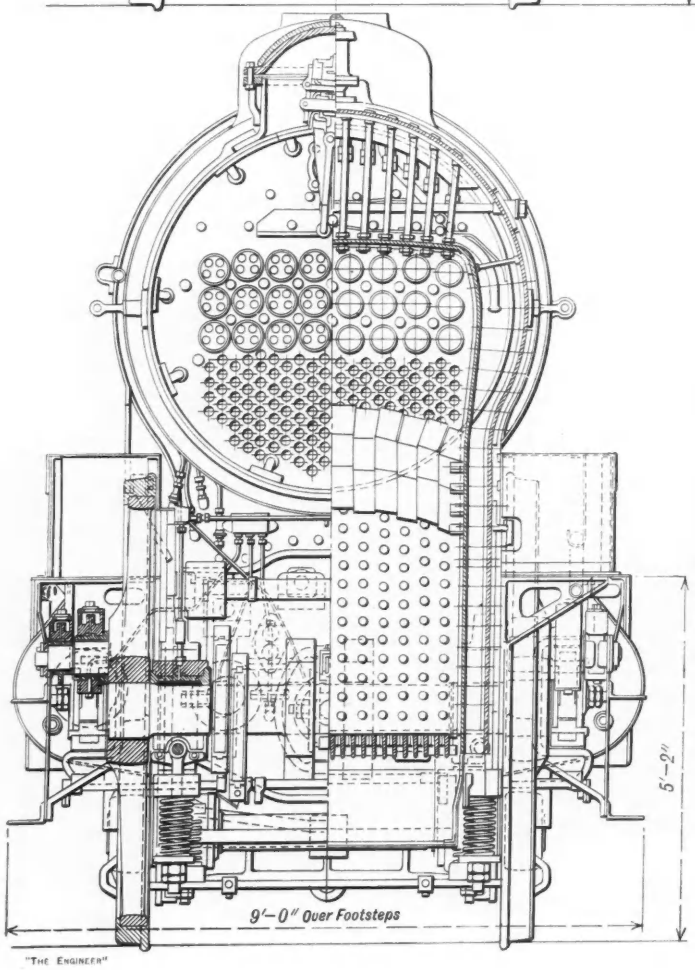
GEORGE T. GLOVER, M..CE.

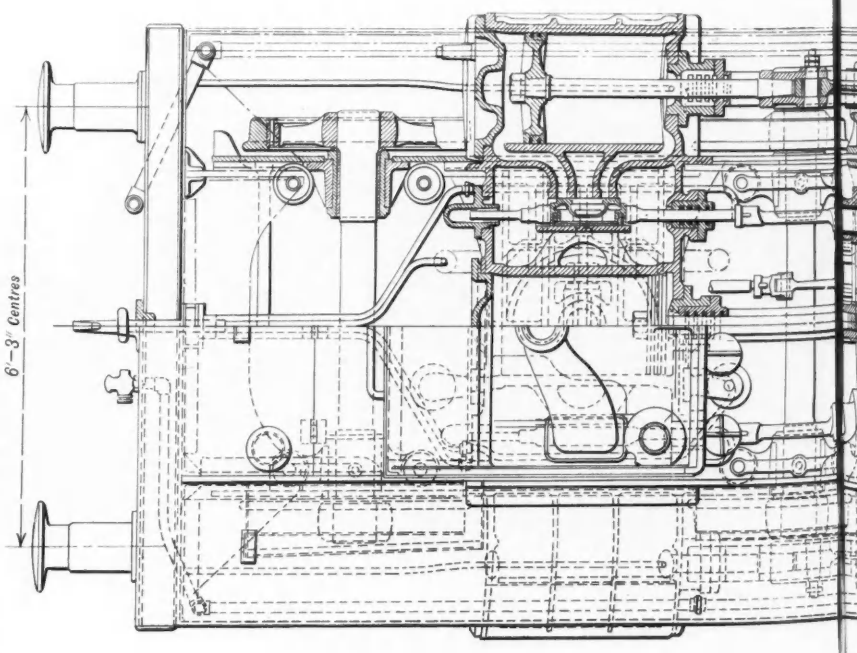




12 T. - 1 C. - 0 Q.

12 T. - 1 C. - 0

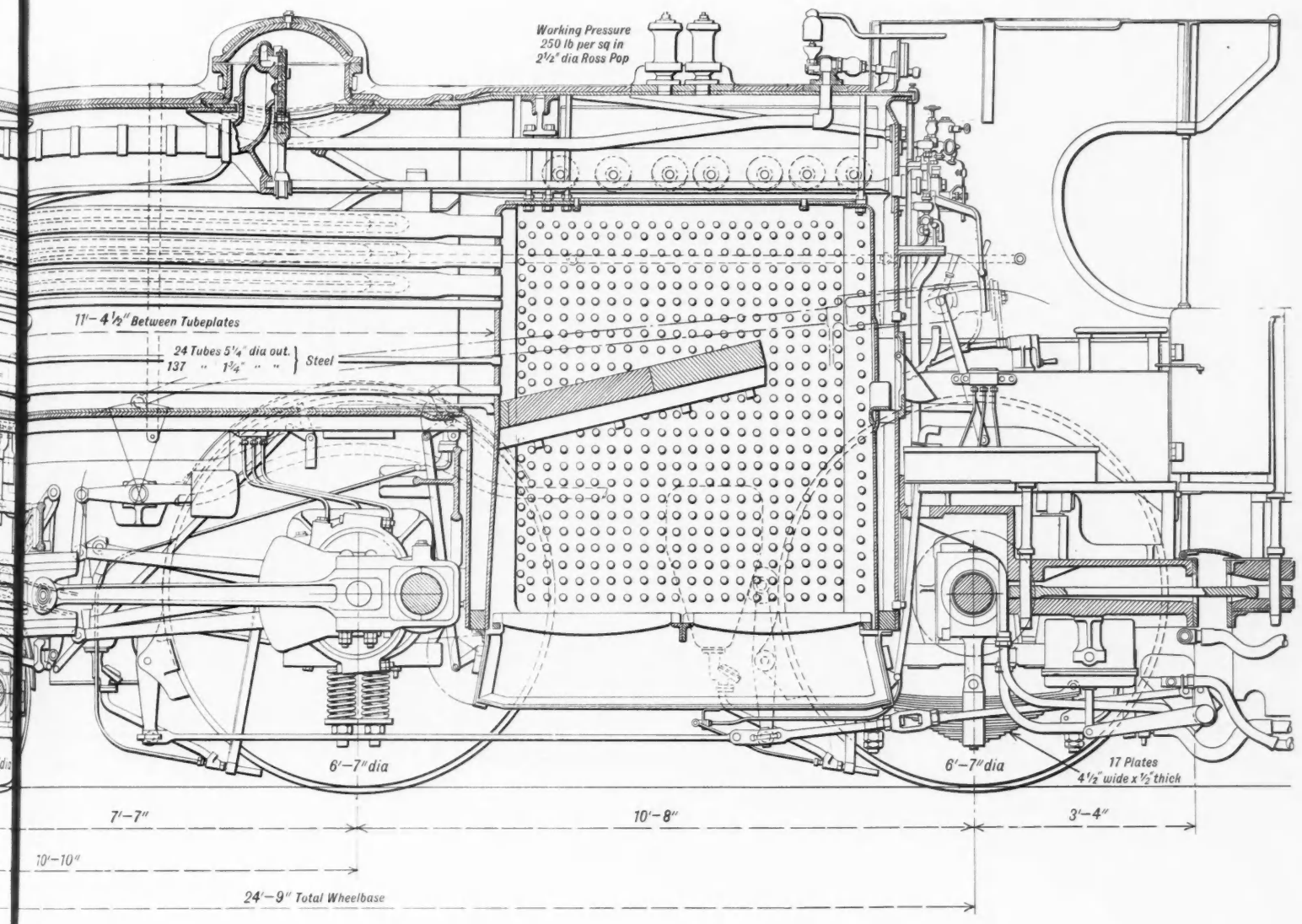


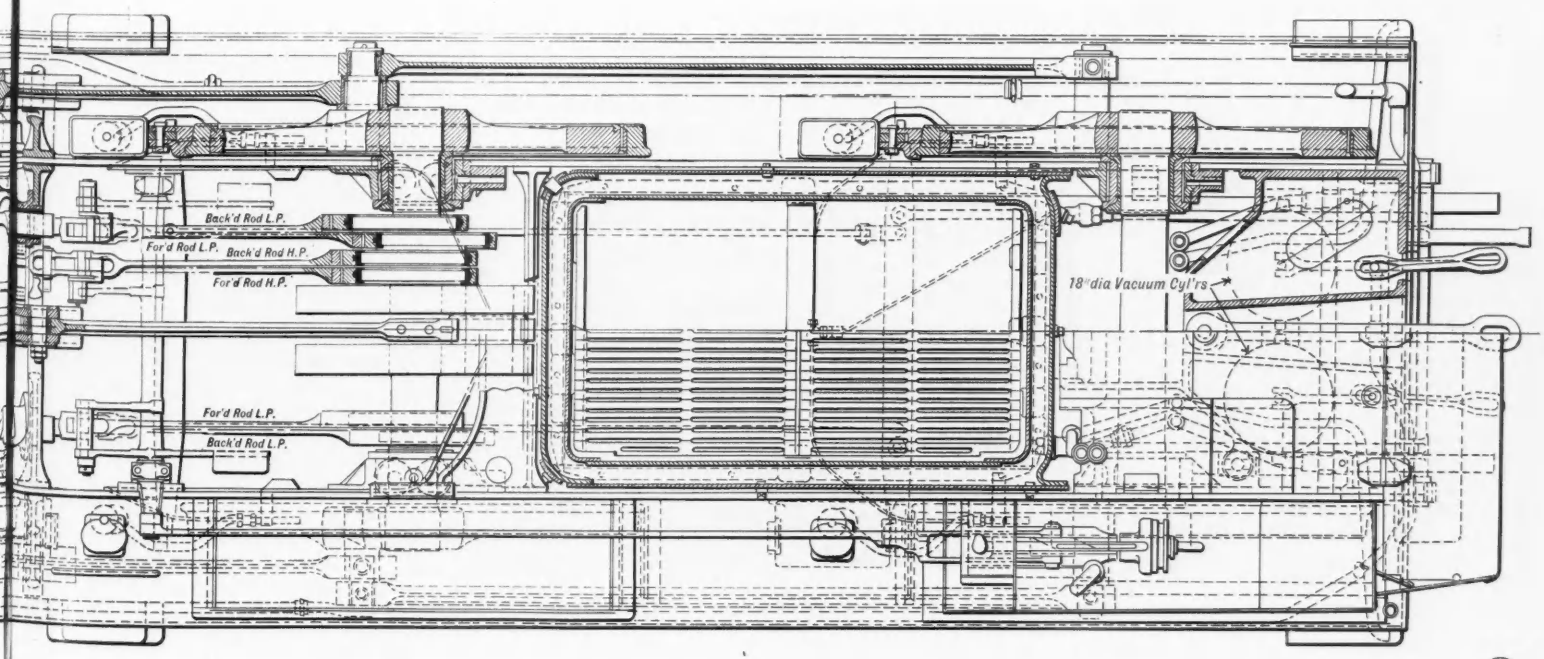


"THE ENGINEER"

HR CYLINDER COMPOUND EXPRESS LOCOMOTIVE

M CE. DUNDALK, ENGINEER





A Seven-Day Journal

The Late Mr. Colin Mackay Jackson.

IT is with regret that we have to announce the sudden death at Troon on Thursday, January 26th, of Mr. C. M. Jackson, managing director of J. H. Carruthers and Co., Polmadie, Glasgow. Mr. Jackson was the elder son of the late Mr. William Jackson, one of the founders of the well-known firm of marine engineers, Dunsmuir and Jackson, Ltd., of Govan, and served his apprenticeship with that firm. Later he was with Messrs. Furness, Withy and Co., of Newcastle-on-Tyne. Before the war Mr. Jackson held a Commission in the Territorial Division of the Royal Engineers, and in 1914 went to France with his regiment. He subsequently served in Palestine, and afterwards was attached to the Admiralty in London, in connection with special work. He was a member of the Institute of Engineers and Shipbuilders in Scotland, and served as Collector of the Incorporation of Hammermen. He was greatly interested in all benevolent work, and was connected with many institutions in Glasgow dealing with the welfare of the community.

The Everest Flight.

ON Wednesday, January 25th, the Houston-Westland aeroplane which is being specially equipped for a flight over Mount Everest, was tested at Yeovil, and reached an altitude of 35,000ft., carrying a pilot and an observer. Mount Everest, as everyone knows since the series of expeditions of a few years ago, is slightly more than 29,000ft. in height, so that the aeroplane would appear to have ample climbing power in hand. The test flight began at ten minutes past ten, the greatest altitude was attained in 74 minutes, and the machine re-landed just an hour and forty minutes after the start. Very special equipment has had to be installed in the machine to meet the very severe conditions. The clothing of the occupants is electrically heated, as are also the surveying cameras that will be used on the actual flight, while oxygen is supplied to the pilot and observer from three cylinders. Complete with all its equipment, the machine weighs 4870 lb. On this test flight conditions probably even more severe than those likely to be encountered above Everest were met. At 20,000ft. the temperature was minus 25 deg. Cent., and at 35,000ft. as low as minus 60 deg. Cent. The test demonstrated that the electrically warmed clothing was quite satisfactory, even for the pilot, who, unlike the observer, is not enclosed in a covered-in cockpit. Both the Bristol-Pegasus engine and the propeller of the machine are specially adapted for high-altitude work, the former being capable of developing 550 B.H.P. at 11,500ft. The recording of a speed of about 140 m.p.h. at 35,000ft. must be regarded as a tribute to the design of the machine and engine.

A Great New Bridge at San Francisco.

CERTAIN details of two bridges to be built at San Francisco were given by the New York correspondent of the *Manchester Guardian* in a recent issue. One of these bridges which, it is stated, will cost 35,000,000 dollars to build, will span the Golden Gate itself, connecting the city to the shore on the northern side, which is at present largely undeveloped. Alone, this bridge, the construction of which has already started, would be noteworthy, but in comparison with another connecting San Francisco with Oakland on the other side of the bay, it pales almost into insignificance. This second bridge will be about 7 miles long and about two-thirds of that mileage will be above the water of the bay. It consists of two parts, one connecting Goat Island with the city and the other Oakland with the island. The first part, crossing a stretch of water 9000ft. wide, will be covered by two great suspension spans supported midway by a concrete pier. These spans will provide a clearance above the water of 214ft. Between Oakland and the island there is to be a cantilever bridge 1400ft. long over the deep-water channel. A tunnel through the hill on Goat Island will connect the ends of the two parts of the bridge. The remainder of the structure, built over shallow water or overland, is unlikely to provide any difficult engineering problems. When completed the bridge is to have two decks. The upper one will take six lines of automobile traffic and have footwalks for pedestrians, while the lower, besides providing for a double tramway track, will accommodate three lines of motor lorries.

Safety in Mines.

Two papers have been issued by the Safety in Mines Research Board dealing with the subjects of fires and explosions in mines. It will be remembered that owing to the difficulty adequately of reproducing the conditions of a mine above ground the Board constructed in 1926 a special building simulating a goaf. It had suitable ventilating roads and was used for the study of gob fires. This building was made use of for the experiments just carried out. In the opinion of the Board, if a fire is to be dealt with by sealing off the sooner the operation is carried out the better. Particular importance perhaps attaches to the statement that the danger of the formation of an explosive mixture is greatest immediately after sealing off, since inflammable gases are still being distilled off, while the atmosphere is not yet non-inflammable from the retention of products of combustion. Of even greater interest, however, is the result of the Board's researches into the amount of oxygen required to maintain heating. The fact that the flame of a safety lamp is extinguished in an atmosphere containing less than 17 per cent. of oxygen cannot be taken as a guide. A sealed off fire can be rapidly revived by an in-leakage only sufficient to raise the oxygen content to 5 per cent. or even less. It appeared that heating might be maintained indefinitely with an oxygen content of less than 3 per cent.

Underwriters and Fires at Sea.

SPEAKING at the annual meeting of the Liverpool Underwriters' Association on Monday last, the chairman, Mr. S. D. Grundy, said that although the number of fires on ships in 1932 was 314, compared with 377 in 1931, owing to the fires on passenger liners, the claims had greatly increased and during the past five years underwriters had paid many millions of pounds for losses resulting from fires. Passenger liner fires had become a problem in themselves, and a committee of all concerned, including classification societies and underwriters, now had the matter in hand. It was useless to theorise as to the causes of those fires, but, as regarded prevention, the Committee of the Association was of opinion that the best safeguard was the organisation of a thoroughly effective system of fire control at all times. A well-known British firm of shipowners recently had to cable to its ships abroad forbidding the practice of attaching radiators to electric fans. Prompt action such as that was most commendable, and probably threw a sidelight on the fact that fires on British ships were not really excessive. Of the 14,000,000 tons of shipping in the world it was estimated that one-third was already obsolete. When trade improved many of those ships would be put into commission and repairs would go up so that underwriters would have to be careful to see that such vessels were adequately rated.

Electric Motor Developments.

IN a paper on "Progress in Electrical Motor Development," read before the Manchester Association of Engineers on Friday, January 27th, Mr. D. B. Hoseason stated that the greatest field for research to secure higher quality was probably that presented by insulation, and it would seem that the natural trend would be from organic to inorganic, and from natural to synthetic materials. Progress towards lower costs would be achieved either when certain of the existing limits lost their present importance, or when new ways and means of overcoming them were found. As the price of power fell, the efficiency of a motor would have less effect upon the total running charges, but as the necessity for maintaining efficiency disappeared, the temperature limit would become more prominent, and it would be essential to adopt more effective methods of cooling, or, alternatively, to find insulating materials which would withstand higher temperatures. Power factor might also become an important limiting feature and give impetus to devices for securing higher power factor characteristics. New fields of application would demand motors with new characteristics, and improvements to the totally enclosed fan-cooled motor would seem probable in order to make the valuable characteristics of that machine obtainable at a cost nearer that of the standard open type motor.

Steel Frame Buildings.

A STATEMENT issued by the British Steelwork Association shows that so far fifty-seven cities and boroughs in the United Kingdom have followed the lead given by the Ministry of Health, the Office of Works, the Department of Health for Scotland, and the Department of Works and Public Buildings of Northern Ireland, in accepting the new British Standard Specification, No. 449, 1932, for use in the construction of steel-framed buildings. Twenty other local authorities are considering the adoption of the standard specification, while replies are awaited from a further sixty municipalities. The replies are steadily coming in and there seems every prospect of the specification being adopted not only in Great Britain, but throughout the Empire. Good progress has been made in New Zealand, and in the Dominion of Canada definite steps will likely be taken in the near future. The City of Toronto is now considering a revision of its code for steel-frame buildings, and there is a prospect that the British Standard Specification will be adopted. In Great Britain the construction of new factories and slum clearances will, it is pointed out, be greatly facilitated by the adoption of the new code.

Scotch Boilers and Pulverised Coal.

A PAPER of unusual practical interest to marine engineers was read on Tuesday evening last, January 31st, before the Institute of Marine Engineers by Mr. W. G. Gibbons and Mr. M. Arthurson, who gave their experience of burning pulverised coal in the Scotch boilers of the steamships "Musician" and "Recorder," belonging to the Charente Steamship Company, Ltd., and managed by Thos. and Jas. Harrison, of Liverpool. In THE ENGINEER of October 30th, 1931, we gave full particulars of the installations and performance of these two steamers, which are equipped with Clarke-Chapman pulverisers and burners. The paper referred to gives further information concerning the design of the equipment and the running of the plant, along with extracts from engine-room logs and operating results. As befitted the occasion, the meeting was a large one and the President of the Institute, Commander C. W. Craven, R.N. (ret.), was in the chair. There was a good discussion and further information was sought as to the calorific values of the coals used and their costs. As to the stowage capacity of coals, it was stated that, whereas Staffordshire and Derbyshire coals work out at 50 cubic feet per ton, Durham coals only require 47ft. and South Wales coals 40ft. for the same weight. A plea for the use of higher calorific coals was made. Some interesting figures were presented on the recent results obtained with two Japanese ships equipped with Clarke-Chapman pulverising plant. In the 14½-knot trials figures of 1·22 lb. to 1·25 lb. of coal for all purposes per I.H.P. hour were obtained, and a figure of 1·16 lb. has since been attained in service. The thermal efficiency of the boilers worked out at 81 to 84 per cent., using 13,320 B.Th.U. coal.

A 20-Ton Coal Wagon Scheme.

THE Great Western Railway Company announced that, in order to assist colliery companies to secure the financial advantages which are to be derived from the use of modern wagon stock, it has arranged with the Government to cancel certain works which were to be carried out under the Development (Loans, Guarantees and Grants) Act of 1929, and in their stead to construct 5000 20-ton wagons, the whole of the new scheme involving an expenditure of about £1,000,000. These wagons are to be let out on hire to approved colliery companies for a period of ten years, with an option to purchase them at a nominal figure at the end of the hiring period. A further condition of the scheme provides that the colliery companies to whom such wagons are hired should break up, or cause to be broken up, obsolete wagons of a total tonnage capacity of not less than that of the new 20-ton wagons. It is pointed out that, apart from the savings in reduced renewal and maintenance charges, which the new 20-ton wagons will give as compared with smaller and older units, the railway company offers special rebates from railway and the dock charges, which amount to 2¾d. per ton, as compared with the charges on coal which is transported in smaller wagons.

The Late Mr. Stanley Walker.

WE have to announce with regret that Mr. Stanley Walker, M. Inst. C.E., Deputy Chief Engineer of the Metropolitan Water Board, died suddenly from pneumonia on Sunday, January 29th, 1933, at his home at Golders Green, at the early age of forty-three years. Mr. Walker was born at Blackpool, and educated at the Blackpool Grammar School, Blackpool Secondary School, and Owens College, Manchester University. He was articled to the late Mr. J. S. Brodie, M. Inst. C.E., of the Blackpool Corporation, and held appointments at Blackpool, Birkenhead, Birmingham, and Plymouth, before entering the service of the Metropolitan Water Board as senior assistant engineer in 1921. In 1926 he was appointed chief civil engineering assistant to the Board, and in 1930 deputy chief engineer. During his service with the Metropolitan Water Board Mr. Walker was closely associated with many of the large engineering works carried out by the Board, including the completion of the Queen Mary Reservoir at Littleton, and the construction of filtration plant and machinery at Kempton Park, Walton, Surbiton, and Brixton. He was looked upon as a highly efficient engineer and his untimely death will be mourned by a large circle of friends.

The Shipbuilding Industry.

AN official statement issued by the Shipbuilding Employers' Federation shows clearly that there is undoubtedly the beginning of an improvement in the shipbuilding industry, and that the worst has now passed. The statement calls attention to the fact that after ten months of almost complete stagnation the ordering of new mercantile shipbuilding work commenced in November, and during the period from November 1st up to and including January 26th the following orders have been booked by British shipyards:—Cargo vessels, 20; passenger cargo vessels, 2; small passenger vessels, 2; coasters, colliers, trawlers, tugs and other small craft, 30; gunboat (British), 1; destroyer (foreign), 1; naval sloops (foreign), 2. As a result of these orders it is extremely probable that the figures for new tonnage commenced in British shipyards for the March quarter will exceed the tonnage commenced during the whole of 1932. Since the statement was made further orders have been reported on the Clyde and on the North-East Coast, and the contracts for the two naval programmes will, it is expected, be allocated some time this month. The slow revival of activity in the yards will, it is hoped, put an end to the tragic figures of 60 to 80 p.c. of unemployment which ruled throughout last year.

Heat Transference in Superheaters.

By T. B. MORLEY, D.Sc., M.I. Mech. E.

THE rational determination of the requisite heating surface of a superheater intended for a specified performance involves accurate knowledge of the conditions governing heat transmission to the superheater and the correct application of that knowledge.

Many difficulties, however, are encountered in the attempt to apply rational principles, even in the comparatively simple case of heat transmission by convection only. When radiation also has to be taken into account the conditions are very complex indeed, and the data that one would desire are so scanty as to be almost useless.

Nevertheless, the endeavour to apply such knowledge as is available is useful in that it reveals the influence of factors which otherwise are either overlooked or regarded as of little moment.

The reception of heat by the superheater by means of convection will first be considered. It is now well recognised that the transfer of heat by convection depends upon the rate of flow of the fluids concerned over the walls which separate them. The velocity of the steam in the tubes of the superheater can easily be found—though even here, the assumption that the distribution is uniform in all the tubes which are connected in parallel is not necessarily fulfilled.

It is quite another matter, however, to calculate the rate of flow of the gases over the outside of the tubes. Superheaters are set in chambers—or in parts of the boiler setting—where the flow of gas is not in regular channels of definable area, and the gas at some places flows along the direction of the tubes and at others it flows across the tubes. These differences all affect the transmission of heat.

Then, even for definite cases, the data are still incomplete, and, except in the crudest form, are to be found only in scattered articles and papers, or in books not readily accessible to the average engineer. The data quoted by different writers differ widely and as a rule have to be expressed in formulæ which are rather inconvenient to use.

It is no wonder, therefore, that the proportioning of superheaters is so often effected by purely empirical methods.

An analysis of the stages in which heat is transmitted to the steam in a superheater, and the comparison of the results of this analysis with those observed in practice, are of interest, as they show that even in superheaters of the so-called purely convection type the part played by radiation must be considerable.

In the writer's opinion, too little attention is given by most engineers to the study of the separate stages in the transfer of heat from a heating medium through a partition to a colder substance. If H_1 is the coefficient of heat transfer from the hot substance to the surface of the separating wall, λ the conductivity of the material of the wall, t its thickness, and H_2 the coefficient of heat transfer from the wall to the cold fluid, then the overall coefficient of heat transmission

$$H=\frac{1}{\frac{1}{H_1}+\frac{t}{\lambda}+\frac{1}{H_2}},$$

This applies to flat dividing walls, in which the heat-receiving and heat-giving surfaces on the two sides are the same in area. For tubes the difference of the external and internal areas has to be taken into account.

It is advisable to consider H_1 and H_2, and not to confine attention to H. It is most unfortunate that the reports of many experimental investigations give overall coefficients only; their value would be greatly enhanced if the individual coefficients H_1 and H_2 were also ascertained. The conductivity term $\frac{t}{\lambda}$ is usually very small and may be omitted without appreciable error.

The heat transmission data used in the following calculations are based upon those given—in Continental units—in Schack's "Die Industrielle Wärmeübergang," published in 1929, in which recent theoretical and experimental work is carefully discussed, the resulting formulæ being probably as good a compromise between the strictly rational and the empirical as it is possible to arrive at in the present state of knowledge.

For the heat transfer from gas to tube the formula takes into account the rate of flow of the gas, whether the flow is along or across the tubes, the tube diameter, and, if the flow is across, the number and arrangement of the rows of tubes. Thus, for gas flowing across four rows of tubes, in non-staggered arrangement, the coefficient of heat transmission in B.Th.U. per square foot per hour per degree Fah. is given by

$$H_1=7\cdot59\,\frac{\left(\frac{w}{a}\right)^{0\cdot654}}{d_o^{0\cdot346}} \quad . \quad . \quad . \quad . \quad (1)$$

where $\left(\frac{w}{a}\right)$ is the mass velocity of the gas in pound per second per square foot of cross-sectional area of the gas path, and d_o is the external diameter of the tube in inches.

If the gas flow is along the tubes the appropriate formula is

$$H_1{}^1=4\cdot29\,\frac{\left(\frac{w}{a}\right)^{0\cdot8}}{\sqrt[4]{d_o}} \quad . \quad . \quad . \quad . \quad (2)$$

As already indicated, the evaluation of w/a, since it includes the area a, presents difficulties, and only approximations are possible.

For a superheater as usually set in relation to a Lancashire boiler, w/a at normal full load output is in the neighbourhood of 0·3 to 0·37—say, 0·34 for cross flow and 0·36 for longitudinal flow. If the tubes are 1·81in. external diameter, these values of w/a give $H_1=3\cdot05$ and $H_1{}^1=1\cdot63$ respectively.

In the next stage, conduction through the metal, the resistance to heat flow is negligible in comparison with the convective resistances at the outer and inner surfaces.

The coefficient for the third stage, transference from tube to steam, may be calculated from the formula

$$H_3=(6\cdot85+0\cdot00239\,t)\,\frac{\left(\frac{w}{a}\right)^{0\cdot79}}{d_i^{0\cdot16}\,L^{0\cdot05}} \quad . \quad (3)$$

where d_i is the internal diameter of the tube in inches, L the tube length in feet, and t the mean steam temperature in degrees Fahrenheit.

For steam at 200 lb. per square inch absolute, $t=450$ deg. Fah., $d=1\cdot5$in., L the effective length of the tube (*i.e.*, the length effectively exposed to the flue gases)=13ft., and $w/a=14\cdot76$, which corresponds to a mean steam velocity of 38ft. per second in the tubes, $H_3=54\cdot8$ from the above formula.

These individual coefficients must be used in conjunction with the temperature differences between gas and metal, and between metal and steam respectively; the "overall" coefficient, applicable to the temperature difference between gas and steam, which can be used without the metal temperature being first determined, is, if referred to the external tube surface, given by

$$H_3=\frac{H_1\times H_2\times d_i}{H_1\,d_o+H_2\,d_i} \quad . \quad . \quad . \quad . \quad (4)$$

Taking the external coefficient for cross flow, the overall coefficient for the example becomes $H_3=2\cdot86$; for gas flow along the tubes, H_1 is replaced by $H^1{}_1$, and H_3 becomes 1·58.

It is known that the coefficients to be used in the ordinary convection formula, deduced from observation of superheaters such as the one in question, are much higher, being, in fact, for the conditions indicated, of the order 5 or 6.

The large discrepancy is accounted for by the fact that heat is also conveyed by radiation, even in this type of superheater.

The formula usually employed in calculating heat transference by radiation is

$$\begin{aligned}Q&=\text{heat units per unit time}\\&=c\times A\times\left[\left(\frac{T_1}{1000}\right)^4-\left(\frac{T_2}{1000}\right)^4\right] \quad . \quad (5)\end{aligned}$$

where A is the area receiving radiant heat, it being assumed that this area is completely enclosed by the radiating body; T_1 T_2 are the absolute temperatures of the "hot" and the "cold" bodies respectively; and c is a coefficient depending on the nature of the two surfaces and on the absorbing qualities of the intervening atmosphere with regard to radiant heat.

Calculations of great elaboration have been made for the conditions in boiler furnaces, using formulæ of this type. While the attempt to analyse the factors involved in the heat transference in this exceedingly complicated case should not be deprecated, it must be admitted that the difficulties are so great in the present state of knowledge that such calculations have little practical value.

The circumstances of a superheater, placed in a setting behind the boiler, where the temperature of the gas surrounding it can be directly measured, and where it is not exposed to radiation from the grate and from incandescent gases, are much simpler. The calculation still, however, presents serious difficulties, *e.g.*, the choice of that proportion of the superheater surface which is exposed to radiation from the brickwork of the enclosure, the choice of the radiation coefficient applicable to the case, and the determination of the temperatures T_1 and T_2. Thus, T_1 is not the gas temperature but that of the brickwork, which must be lower, since the walls of the superheater chamber are transmitting heat to the superheater by radiation, and can have their temperature maintained only by receiving heat by convection and radiation from the gases, which necessitates a difference of temperature. The carbon dioxide and the water vapour in the gases themselves radiate heat, both to the walls of the chamber and to the superheater, and the gases are not perfectly transparent to radiation, but absorb a proportion of it.

A discussion of these interacting factors is beyond the purpose of the present article.

It is of some interest, however, to calculate the radiation to the superheater on the assumption that formula (5) can be applied, the temperature T_1 being such as to give a radiation equivalent to that required to make up the difference between the observed overall coefficient and the convection coefficient obtained by calculation.

It is assumed that c is about 1400, Q being in B.Th.U. per hour, T_1 T_2 in degrees Fahrenheit abs., and A in square feet. For the example, A is assumed to be 30 per cent. of the entire superheater surface. Let t_1 be 1000 deg. Fah., so that T_1 is 1460, and let the temperature of the superheater tubes be t_2.

Then the heat received by the superheater as a result of radiation is

$$1400\times0\cdot3\,S\left[\left(\frac{1460}{1000}\right)^4-\left(\frac{t_2+460}{1000}\right)^4\right] \quad . \quad (6)$$

The heat transmitted by convection, with cross flow of the gases, for which $H_1=3\cdot05$, is

$$3\cdot05\times S\times(1000-t_2) \quad . \quad . \quad . \quad . \quad (7)$$

The tubes being 1·5in. internal and 1·81in. external diameter, the internal heating surface is

$$S\times\frac{1\cdot5}{1\cdot81}$$

The heat transmitted to the steam (using the coefficient already found) is

$$54\cdot8\times\frac{1\cdot5}{1\cdot81}\,S\,(t_2-450) \quad . \quad . \quad . \quad (8)$$

Equating the sum of (6) and (7) to expression (8), and solving for t_2 (which must be done by trial and error), t_2 is found to be 518 deg. Fah., or 978 deg. Fah. abs.

The heat transmitted by radiation thus becomes

$$1400\times0\cdot3\left[\left(\frac{1460}{1000}\right)^4-\left(\frac{978}{1000}\right)^4\right]=1522\text{ B.Th.U.}$$

per hour per square foot of total superheater surface.

The temperature difference being 1460−978 =482 deg., the equivalent coefficient in the linear equation $=\frac{1522}{482}=3\cdot16$.

The overall coefficient for purely convective transmission being 2·86, the total heat transmitted would thus be arrived at by using an overall coefficient of $3\cdot16+2\cdot86=6\cdot02$ in the customary linear equation.

If the condition of longitudinal flow of gas were assumed, similar calculations would give the tube temperature 502 deg. Fah., the equivalent coefficient for the radiant transmission 3·10, and the total coefficient $3\cdot10+1\cdot58=4\cdot68$.

Perhaps the most important deduction to be drawn from an analysis such as the above is that the conventional coefficients, like all empirical "constants," are applicable only to cases resembling closely those from which they have been derived, and that in consequence the coefficients that may be used for superheaters set behind boilers will be considerably at fault if used for independently fired superheaters, where the temperatures of the gases and the brickwork are much higher and the radiant transmission therefore forms a greater proportion of the whole.

Thus, calculations similar to those shown above, with the equivalent radiating temperature 1500 deg. Fah., lead to overall coefficients 8·93 for cross flow and 7·65 for longitudinal flow of the gases.

An independently fired superheater, proportioned according to the coefficient that is suitable for an ordinary boiler setting, may thus be much too large.

The analysis justifies the practice already in vogue, as indicated in certain reference books, of increasing the "constant" in the ordinary formulæ as the rating of the boiler (steam evaporated per square foot of heating surface) is increased, since increased rating involves increased temperature, and of adopting a still higher coefficient for separately fired superheaters.

The part played by radiation in heat transference in many appliances used in engineering practice is becoming increasingly recognised. There is evidence that, even for gases flowing through tubes at comparatively low temperatures, say, 600 deg. Fah., transmission by radiation is not a negligible proportion of the entire transmission.

Further study of the intricate phenomena involved and, in particular, further data for practical application are greatly to be desired.

AN increase is noted in the amount of investigative work undertaken in the technological laboratories of the Mines Branch of the Federal Department of Mines, Canada, notably in those of the ore dressing and metallurgical division, in which the increased interest in gold mining operations is reflected. During the past year a fully equipped laboratory for the microscopic and spectographic examination of ores and minerals was added to the division's facilities. Large-scale technical tests carried out on certain Canadian coals demonstrated their suitability, when properly prepared and when mixed with other coals, for use in the production of good domestic coke and gas. An increased demand on the testing facilities of the Ceramics Division is also reported. Because of its establishment at a time when the Canadian ceramic industry was in the earlier stages of development this division has been able to render particularly valuable service to the ceramic industry, a service which during the last fiscal year resulted in the putting into commercial use of several of the processes devised in the laboratories.

The International Railway Congress.

No. III.

(*Concluded from page 87, January 27th.*)

ROLLING STOCK—COACHES.

QUESTION VI. relates to "All-metal rolling stock; carriages and wagons; use of light metals and alloys; use of autogenous welding." The three reports are, respectively, presented by Mr. H. N. Gresley, of the London and North-Eastern Railway, for America, the British Empire, China and Japan; Mr. R. Mariani, of the Italian State Railways, for all countries except those covered by Reports I. and III.; Herr Dähnick, German State Railways, for Germany, Bulgaria, Denmark, Finland, Norway, Netherlands and their Colonies, Roumania, Sweden, Czechoslovakia, and Turkey.

This was one of the subjects dealt with at the Madrid Congress of 1930, and that fact, no doubt, prompted Mr. Gresley to say in the opening paragraphs of his report that, owing to the comparatively short period which has elapsed since the Madrid meeting, and to the subsequent generally prevailing depression in the railway industry, the progress in the construction and design of all-steel rolling stock has not been as extensive as might have been expected during that period. Valuable and interesting information has, however, been obtained in the use of all-metal construction for wagons, and in the use of light metals and alloys, and of welding for both carriages and wagons.

In the United States, all the railway companies, with the exception of the Delaware and Hudson, have adopted the all-metal carriage for many years, and are continuing that policy. They consider that they obtain greater strength and longer life; also maintenance costs and risks of fire are greatly minimised. The Delaware and Hudson officers, on the other hand, are in favour of a composite construction, which they regard, if properly used, as equal in strength to the all-steel car. Their experience is that it is easier to maintain and more comfortable, as it is not subject to the sudden changes of temperature which are met with when all-steel cars are used.

In Great Britain all-steel coaches have only been used to a comparatively limited extent, except in the case of electrified railways. The company with the largest proportion of all-metal main line coaches is the London, Midland and Scottish; 2·7 per cent. of that company's total stock is constructed in that way. On the London and North-Eastern the position is similar, except that the proportion is only about 1 per cent.

A large proportion of stock on English railways is constructed, in order to meet the traffic requirements, with side doors to each compartment. The usual design of all-metal construction is not as advantageous in the case of carriages which are provided with side doors, as with carriages having doors at the ends only. All-metal carriages are found to be more costly to construct and are heavier than carriages of which the bodies are made of wood. A sufficient period has not yet elapsed to permit any conclusion as to the comparative cost of maintenance, and, although the use of all-metal carriages is an innovation of recent years, experience seems to indicate that maintenance is likely to prove heavy, owing to corrosion of panels. That, no doubt, is largely influenced by the climatic conditions which prevail. In the Far East, considerable progress has been made in Japan, where since 1926, all new carriages have been of all-steel construction. It is considered that that is justified on the ground of safety and probable durability.

The policy of building all-steel vehicles has been continued in the United States since the Madrid meeting, and opinion appears to be divided on the question of utilising the body as part of the structure. On the Pennsylvania system and on the Philadelphia and Reading Railway, the body is constructed quite independently of the underframe, whereas, on the New York Central and on the Baltimore and Ohio, the body forms an integral part of the structure. Since the previous reports on this subject, the London, Midland and Scottish is the only British railway, exclusive of the Metropolitan District and the London Electric railways, which has added to its all-metal stock. What has been done on that system is to provide a few vehicles which are fitted with end doors only, and have the bodies rigidly secured to the underframe and forming part of the main structure. In the new all-metal cars, used in main line, suburban and metropolitan services in Japan, the body and underframe are constructed as a single structure. In contrast to the older type of steel carriages there, which were built with fish-belly centre sills in order to resist the end shock and to carry the total vertical load, the new vehicles have lighter centre sills and are built up of channels and plates, leaving the greater part of the load to be carried by the side framing. In place of the clerestory type of roof, which was used on the older carriages, an elliptic roof has been adopted with a view to increasing the strength and decreasing the cost.

The London, Midland and Scottish Railway assembles the body, side, roof, and ends in jigs; the body is constructed on two main longitudinal members—the cant-rail and the curb-rail. These members are fixed and gauged in the body side jigs. The body side pillars and panels are bolted to the above members before riveting. A similar method is adopted for the roof and ends. Soft-iron rivets, $\frac{1}{4}$in. to $\frac{5}{16}$in. diameter, are used, fixed cold for body sides, end panels, and roof. In places where larger rivets are used, they are of mild steel and are driven hot. Electric arc welding is used for butt joints exposed to the weather. The precautions taken to prevent local deformation and buckling are: (1) Sufficient clearance between plates; and (2) correct electrodes and current values used. Owing to limited experience it cannot be said if welding can advantageously be substituted for riveting, and what saving in weight would be effected.

The London and North-Eastern Railway has decided to construct one carriage body of "Alpax" aluminium alloy. The sides, ends and doors will be all-alloy castings, suitably ribbed and strengthened, and riveted to a steel framework forming pillars and cant-rails. The roof will be of duralumin sheets, carried on "Alpax" carlines, and it is anticipated that a reduction in weight of 8 per cent. will be effected. The same company also uses "Alpax" for such fittings as door drop lights and quarter-light moulding. The London and North-Eastern employs "Alpax" fittings in all classes of stock, and has recently introduced steam-heat couplers and vacuum brake couplers made of that metal. On the Metropolitan District and London Electric Railways "Alpax" is being largely used for seat frames, seat handles, hand-strap brackets, sundry interior fittings, and doors.

In England it has not been found necessary to use any insulating material on the inside of the steel panelling, but between the interior wood casing and the outside panelling there is a continuous space, which is open to the atmosphere, along its bottom edge and through torpedo extractors at the top. This has been considered a sufficiently good non-conductor of heat to meet climatic variations. It has not been found necessary to increase the area of the steam-heat pipes in carriages constructed of steel. From the replies of other countries it would appear that in climates where the temperature is generally mild, no special means are necessary for heat insulation. In countries where, however, extreme temperatures are experienced, non-conducting material must be attached to the interior of the steel panels. In tropical countries, where the carriages are subjected to direct radiant heat, sunshade panels must be fitted as an additional precaution.

In the general remarks with which he concludes the subject of carriages, Mr. Gresley observes that the replies, when considered as a whole, show that no definite decision in favour of any particular form of construction can be made. The decisions already come to have, in each instance, been influenced by local and climatic conditions, by the methods of operation and facilities for maintenance; in certain cases they have been inspired by the practice of the countries controlling the railways. The question of safety has, in some cases, been regarded as of primary importance and steel stock has been adopted in many instances for that reason. In view of the comparative freedom from accidents on railways the question of safety should not solely decide the matter. Other important factors must be considered, viz., (1) the comfort of passengers; (2) first cost and maintenance.

The factors just mentioned are then enlarged upon, and Mr. Gresley observes that the comfort of the passenger depends upon: (*a*) smooth running and quietness; (*b*) upholstery, interior decorations, and other amenities; (*c*) adequate lighting, heating, and ventilation. None of these desiderata is enhanced by the use of all-metal stock, and, as regards heating, ventilation, and quietness, the advantage lies with the wooden body. On the factor of first cost and maintenance it is remarked that comparisons which have been made between the first cost of the two methods indicate generally that the first cost of the all-metal carriage is greater than the first cost of the wooden carriage, and, if light alloys are used to any large extent in the construction, the cost will be still greater. On the other hand, it must not be forgotten that in the case of carriages built of light metal alloys the residual value is much greater. No definite conclusion can be arrived at as to the comparative cost of maintenance as a sufficiently long period has not elapsed since the introduction of all-metal stock. There is, however, considerable apprehension that the cost of maintenance of all-steel stock will be greater than of similar stock constructed of wood. The difference will not, though, be so greatly marked with stock which is subjected to a considerable amount of rough usage.

ROLLING STOCK—WAGONS.

An entirely different tone is adopted by Mr. Gresley when he comes to deal with wagons. In this section, he says, the tendency is towards all-metal construction in spite of the difficulties experienced through corrosion. The reasons for that tendency are: (1) all-metal stock stands up better under the rough usage to which wagons are subjected; (2) the increasing difficulty in many countries in obtaining suitable timber at reasonable prices, especially as a result of the increase in size of the vehicles.

The replies received from the administrations concerned reveal a movement towards standardisation of design for the usual types of wagon. The practice in Great Britain may be quoted as an example. There, open goods and some other classes of wagons are in common use as between the four main line companies. As a result of this, wagons built by any one company circulate over the lines of, and are used by, the other companies. Consequently the standardisation of the usual types of wagon has been facilitated. So far the following standard wagons have been designed:—12-ton open goods wagon; 12-ton covered goods wagon; 12-ton mineral wagon; and 20-ton mineral wagon. Of these, only the 12-ton covered goods wagon and the 20-ton mineral are of all-metal construction.

In Great Britain the construction of metal wagons will be developed to a limited extent only. On the Great Western the practice, in regard to open goods wagons, is to make the floors and sides of timber carried on an iron or steel underframe. Wooden bodies are preferred to steel ones by the goods department. The London, Midland and Scottish is still carrying out experiments and has not yet sufficient information as to costs, &c., to decide what the policy shall be. The London and North-Eastern will construct metal wagons to a limited extent according to the material to be conveyed. That policy is influenced by the fact that most of the company's shops are laid out to deal with the building and repairing of timber-constructed wagons.

The replies from New South Wales and New Zealand favour all-metal wagons; the former finds that the maintenance costs are reduced. In India it is the policy of all the railways to develop the construction of all new wagons in metal. The East Indian Railway states that the life of a mild steel wagon there is 33 per cent. longer than of one constructed of timber and the maintenance charges are considerably less. On the Bengal-Nagpur all-metal wagons have proved satisfactory in service and are less expensive to maintain than wood or part steel and wood wagons.

The summary of that part of Mr. Gresley's report which deals with wagons says that the replies show that the general tendency is towards metal construction for wagons, in order to provide greater strength to resist the rough treatment to which goods wagons are subjected. In order to overcome the corrosion, which is particularly destructive in the case of mineral wagons, iron is used, in some cases, in preference to steel, but copper-bearing steel is more generally employed. Timber is still being used to a large extent for the bodies of wagons and there does not appear to be any prospect of its use being entirely eliminated by metal. Whilst riveting is the more general method used for connecting together the details of wagons, welding is being experimentally tried on a wide scale. The results are not yet conclusive, and although a reduction of weight of from 10 to 15 per cent. is mentioned in some instances, no evidence is yet available as to the eventual savings in regular practice. The cost of welding appears to be appreciably higher, as would be expected from the amount of labour required. Both electric arc and autogenous welding are used; no definite preference for one or the other system is observable from the replies. No general practice as to heat insulation is followed; wood linings, with air spaces, are the most common practice. Condensation inside steel stock causes trouble in some countries and the measures taken to overcome it are to line-out the vehicle with wood, or to coat the interior with paint paste and apply granulated cork or sawdust, which is then painted over. Finally, it is satisfactory to note that there is an increasing tendency towards standardisation of design, as it has a marked effect on the cost of construction and also on the cost of maintenance.

Herr Dähnick, in recording the experience of the German State Railways as to all-metal carriages, says that they have continued to extend their use. The experience with some 10,000 steel carriages that had been constructed by the beginning of 1930, and with the additional all-metal vehicles that have been built since that time, has been so favourable that a reversion to building passenger coaches of wood construction could only be considered as a retrograde step. Adherence to the policy adopted by the German railways has enabled them to make progress of a particularly important character in recent times. The use of autogenous welding and careful adaptation of the details of design have enabled the railways to effect considerable reduction in weight without employing expensive light metals and light alloys. Using steel alone, the weight of an express train coach has been reduced from 46·3 to 36·9 English tons, equivalent to approximately 20 per cent. That has been achieved without alterations in the manner in which the space is divided or to the dimensions which affect the comfort of passengers. Moreover, the rigidity and strength of the coaches to resist collision have not been diminished.

Whilst riveting continues to be used for the new steel vehicles now under construction, seven carriages

for through express trains and six eight-wheeled carriages for ordinary express trains have been put in hand as an experiment in which the fullest use is to be made of the latest methods of uniting the steel parts by welding and of utilising high-grade steel. The riveted vehicles enabled noteworthy reductions in weight per passenger, per unit of floor surface, and per unit of overall length to be made, as compared with the older carriages of wood construction. With the experimental carriages it is, however, the aim to achieve further considerable reduction of weight for carriages of the same dimensions and strength. Success in that direction is not unlikely in view of the satisfactory results already obtained with welded bogies, which are the parts that are subjected to the greatest strains in service.

The German State Railways do not at present contemplate the use of steel construction for ordinary goods wagons, because these simple vehicles would be heavier and more expensive and difficulties would arise in the securing of certain classes of freight. At one time a number of all-steel open wagons were built, intended principally for transporting coal. They represent 6 per cent. of all the available goods vehicles and were manufactured as far back as 1893 to 1924. Large wagons, for transporting material in bulk, that are constructed for self-emptying, and smaller self-emptying wagons, used only for the transport of freight that can be shot, have been made in all metal. Wood is not suitable for such vehicles, as the special shape of the self-emptier usually renders it essential to employ steel. Wood is subjected to too much wear and tear, especially if the usual modern practice of loading by machinery is in use. In the latter event the bulk material is then delivered from above and the vehicle receives the impact of a large mass of material. The number of steel large-capacity wagons, hopper, ballast, and earth-tipping wagons is 0·4 per cent. of the total number of goods vehicles.

The summary of the report by Mr. Mariani says that the most remarkable items of progress, from the point of view of the general characteristics of the most recent metal coaches, whether of the method of construction or the materials used, are the following: Increase in the general dimensions of the vehicle and the compartments; improvement in the structure of the body as regards the shock-resisting arrangements; extension of metal construction to the inside partitions, to the roof, to the ends, to the floor, and to the inside linings of the body sides; improvements in the connections of the cross partitions with the body framing so that they can assist, in an effective manner, in cross-bracing the body; realisation of outside surfaces which are sufficiently smooth even where the outside plates are secured by riveting with countersunk rivets; by reducing to a minimum the exterior strap plates.

On the European railways covered in this report all-metal construction has been used in the case of open wagons—flat and high-sided—owing to its superiority from the point of view of strength, maintenance, and the ratio between the load and the tare. On the other hand, a mixed construction of metal for the frame and body framing and of wood for the panels is preferred for covered wagons because usually the heat insulation is thought to be better.

Autogenous welding, as a method of assembling the members of coaches and wagons, has only come into general use on one or two railways. However, its use, in place of riveting, in the less important joints becomes more general day by day, and investigations, as well as tests, for a still wider use of welding are being carried out everywhere very actively.

As yet we have only covered the eighteen reports on the six questions dealt with in Sections I. and II. There remain the seven questions that are being considered in the other three sections, but only one of these may be considered as of general interest to engineers. That is Question IX. on automatic train control.

AUTOMATIC TRAIN CONTROL.

On this subject Mr. G. H. Crook, of the Great Western Railway, reports for America, the British Empire, China, and Japan; Mr. Vlaïkoff, of the Bulgarian State Railways, for Belgium, Spain, France, Italy, Netherlands, Portugal, and their Colonies, Denmark, Finland, Luxemburg, Norway, and Sweden; Herr Stäckel, of the German State Railways, for the other countries.

The report by Mr. Crook is valuable for the history it gives of automatic train control in this country, and of the principal patents taken out, and for a description of the various systems available. If does not, however, offer any opinions, but submits twelve questions for discussion. The questions submitted reveal some of the difficult points in A.T.C., as will be appreciated from the following list; it will be noticed, too, that the questions include automatic train control, and engine, *i.e.*, cab, signals. (1*a*) Where automatic train control or engine signalling is installed in two-position home and distant systems of signalling, is it necessary to retain the fixed visual distant signal? (1*b*) In automatic block systems, particularly those employing three, four, or more-aspect signals, is it necessary or desirable to retain fixed visual track signals; if so, at what points? (2) Where signals are provided on the locomotive, (*a*) is it preferable for them to be of acoustic or visual type or both; (*b*) if of visual type, should they be supplemented by an acoustic device and *vice versâ*? (3) Where signals are provided on the locomotive, is it not also desirable to effect some control of the brakes? (4) With locomotive signals or automatic train control should (*a*) cancelling or (*b*) forestalling be permitted, and under what circumstances? (5) Systems with movable track devices: (*a*) Are they practicable and satisfactory in operation? (*b*) Are there any restrictions as to their usage? (6) The relative advantage and disadvantage of (*a*) continuous and intermittent systems, (*b*) non-contact and contact systems: Are they sufficiently pronounced as to exclude the use of any one system? (7) In intermittent systems, assuming that track signals are retained, where should the track transmitter be placed—(*a*) before reaching the signal and how far from it? (*b*) in close proximity to the signal? (*c*) beyond the signal and how far? (8) With locomotive signals (*a*) is a distinctive "clear" signal necessary or desirable? (*b*) If so, should this be given by an entirely different function from that giving the "warning" signal? (9) Excluding systems using train stop devices as on the London "Underground" Railways and tubes, is an overrun section beyond the home signal necessary or desirable where systems are equipped with automatic train control applying to the distant signal? (10) Can any standard of pre-existing signalling and/or traffic be defined as a necessary preliminary to the equipment of (*a*) intermittent or (*b*) continuous automatic train control systems? (11) Where signalling systems are operated by intermittent telegraphic applications, are not intermittent train control systems appropriate and satisfactory? (12) Should locomotive signals and/or automatic train control be made responsive to speed restrictions—as for curves, &c.—which restrictions are not usually considered integral with the normal system of signalling?

Whilst report No. 1 was of unusual interest because of its author's connection with the Great Western Railway, that by Mr. Vlaïkoff is attractive because it covers France, where cab signals—on the Northern Railway—have been in use since 1878. It is instructive to note that this report records that out of forty-four replies received from the administrations for which Mr. Vlaïkoff is reponsible, twenty-one recorded that automatic train control or cab-signal devices were not used. The answers from the French railways were particularly instructive; whilst they were in a contrary sense to the twenty-one replies just mentioned, all recorded the use of cab-signals only. Thus the Eastern system observes that, being well satisfied with the apparatus fitted to its locomotives that gives audible indications of signals at "danger," as well as recording them, it does not feel called upon to undertake tests with devices which operate the brakes automatically when a signal at "danger" has been passed. The experience of the Northern Railway is yet more instructive. As said above, cab-signals were introduced on to that system in 1878. These acted on the brakes. In 1898, however, the control fittings on the locomotives were removed because they worked very irregularly. Since that time no devices of the kind have been used and up to the present no new tests have been carried out, as the experience of other railways has given rise to very strong criticisms, especially with regard to the premature, rough, and hard brake action. The Midi, Etat, and P.L.M. railways use cab signals and speed-recording devices; the Paris-Orleans makes a similar report, but adds that the Rodolausse system of automatic train control is fitted experimentally to ten locomotives on 27·3 miles of track. It is said, however, that it has had to be altered several times; for speeds below 7·5 m.p.h. it gave very bad results; with higher speeds and when kept in good order the proportion of failures was about 1·5 per cent. The Belgian National Railways have cab signals and speed recorders, and have ordered ten sets of automatic train control, but they had not been delivered when the report was prepared. The Italian State Railways are about to try cab-signals, and the Swiss Federal Railways has one engine—and five engines were being equipped—for automatic train control on a length of 19·3 miles.

In its turn the report by Herr Stäckel is of interest, inasmuch as it covers German practice; also because he was the reporter for Germany—but for no other country—at the Madrid Congress. Herr Stäckel records that three methods of train control are in use on the German National Railways:—(1) The mechanical train stop on the Berlin and Hamburg city and suburban lines; (2) the "Indusilor" electro-conductive train control system; (3) the "Opsi" optical train control. As system (1) is fairly similar to that used on rapid transit lines in London, New York, Boston, &c., there is little occasion for us to record what Herr Stäckel says about it. It is, however, noteworthy that he should observe that the good results obtained with the mechanical stop in heavy suburban traffic have naturally led to frequent and thorough discussion as to the possibility of extending the application of this simple type of automatic train control to the whole system, and especially to lines carrying high-speed traffic, as test results show that breakages of the highly elastic levers, mounted on the motor vehicles, do not occur, even at high speeds. It was, however, appreciated that the control could not be put on the home signal, as it would, in order to obtain full braking distance, have to be some 2300ft. from the fouling point. It is, the report observes, certainly noteworthy that efforts are being made to make the mechanical type of train stop suitable for lines carrying express traffic. The "Indusilor" system (2) is in operation on 726 miles, and equipped to 125 locomotives. It is said to be in the nature of a large-scale experiment, the cost of which is borne by the National Railway Company. The system is described in the report, but no results are given. The latter remark also applies to the "Obsi" optical train control, which is in use on 119 miles and fitted to four locomotives.

The attitude of the German railways towards automatic train control may be judged by two remarks in the conclusion of the report. It is observed that savings in running costs by the automatic control of the trains are not to be anticipated in Germany, owing to the completeness of the signalling arrangements, which meet all the requirements for the free movement of traffic. On the other hand, an increase in running costs would arise on account of supervision, maintenance, and renewal of the apparatus. For several years attention was drawn to the over-running of stop signals on account of the accidents which happened, involving many casualties, but in recent years that has not been the case. Altogether, the frequency of accidents has greatly diminished, owing principally to the falling-off of traffic, as a result of the economic conditions, which brought about easier operations. Better attention is now given to home signals as a consequence of a warning board which has been installed on the approach to a distant signal. In these circumstances, and in view of the present economic position of the German National Railways, there is no prospect of a rapid development of the automatic control system.

Brooklyn-New York Power Cables.

POWER cables have recently been laid on the bed of the East River, New York, under unusual conditions in order to link a large central station on the Brooklyn shore with a distributing system designed to serve the electrical needs of the lower part of the Borough of Manhattan. Until the work in question was completed the Hell Gate generating station of the New York Edison and the United Electric Light and Power Companies was, in the main, called upon to carry the load of the so-called "down-town" area of New York City—a region 5 miles and more away from the plant at Hell Gate. This area is an intensely developed section of New York, the financial, commercial, and industrial activities being diversified and of outstanding importance. Furthermore, in certain parts its permanent population is decidedly large, and the demand for electric current is a steadily increasing one. In these circumstances it was a logical engineering step to seek to link the distributing system in the "down-town" area with a conveniently situated generating station across the East River; hence the tie now made between the Hudson-avenue generating station of the Brooklyn Edison Company and the Manhattan system of the other companies already named.

While the new power line is the second of its kind to be placed on the bed of the East River, it is, nevertheless, novel because of the procedure adopted in laying it and also by reason of the type of some of the cables that form the subaqueous connection between the two neighbouring boroughs. The East River is strictly not a river in the ordinary sense of the word; it is actually a waterway between two arms of the sea, namely, Long Island Sound and New York Bay. The tidal periods of New York Bay and Long Island Sound differ considerably, and at certain stages the tides entering the East River from east and west produce conflict and pronounced eddies. The currents at times are consequently swift and strong and have their reflex upon shipping and also upon the nature of the river bed. Where the cable crossing is made the current attains at one point a maximum of more than 6 miles an hour, and over Corlears Reef the strength of the river is sufficient to keep the rock bare.

All navigable waters in the United States are under the supervision of the Corps of Engineers of the War Department, and the Government authorities specified that the East River cables should be so laid that they would not be exposed to injury by the anchors of ships. This requirement entailed the cables being laid in a trench 10ft. deep in mud and silt and 3ft. deep in rock, the latter section being back-

filled with concrete after the cables were in place.

The contract for the necessary trenching and the work of laying the cables was awarded to Allen N. Spooner and Son, Inc., who sublet the trenching to the Great Lakes Dredge and Dock Company. From end to end the trench was approximately 2300ft. long. The bottom of the trench at its deepest section was 70ft. below mean low water at a point where the river bed is composed of silt and mud. The dredger used —see Fig. 3, page 118—was equipped with an exceptionally long boom and fitted with a bucket having a capacity of 3 cubic yards. The bucket was of extra heavy construction and was provided with teeth strong enough to handle blasted rock and to trim the projecting edges of the trench. The drill boat employed for the trenching operations in the rock—see Fig. 4, page 118—carried vertical steam-driven drills mounted on carriages at one side of the craft, the arrangement being such that the drills could be advanced positively from one drilling position to another. The drill boat was anchored in the fairway and shifted in accordance with ranges established on both shores. As is customary in the United States, the drill steels operated within "sand pipes" or sleeves 6in. in diameter, carrying bells of larger diameter at their lower ends for the purpose of covering the holes and preventing the inflow of mud, &c. When the holes reached the prescribed depth the drill steels were withdrawn and the explosive charges lowered directly into the holes with the firing wires connected to them. The advantage of this procedure is obvious when operations such as those now being dealt with have to be carried on in waters subject to strong currents and when divers can be sent down only during the very short period of slack water. The drill holes were spaced 5ft. apart and the trench was 3ft. deep and 10ft. wide. The work was inspected at each slack tide by a diver for the contractor and a diver for the electric companies. The rock was trenched for a distance of 800ft.

When the trenching was completed the exacting and difficult work of laying the fourteen cables in the trench was begun. Seven of the cables are of the so-called "solid" type, and the remainder are of the "oil-filled" type, both types being armoured with steel wire and covered with three layers of jute and asphalt. The solid cables are 4·356in. in diameter and the oil-filled cables are 3·686in. in diameter. In service the cables transmit current ranging from 27,000 to 33,000 volts. Three of the cables form a single feeder that can be used to deliver to Brooklyn energy generated in New York City. Because of the sizes of the cables and the circumstances in which they had to be laid from one side of the river to the other, special arrangements had to be devised for carrying out the work. The accompanying diagram, Fig. 1, indicates how the cable-laying barge was successively moved from shore to shore and its position controlled in such a way that the craft could be held within narrow limits directly over the trench. Steam winches at the four corners of the rectangular barge handled the lines that kept the barge centred while it was being drawn athwart the stream.

Two cables were laid at a time, each cable being wound on a spool holding about 2300ft. of cable. The two spools were set up parallel to each other and so mounted that they could be unreeled simultaneously and at the same rate. The loaded spools weighed up to 77,000 lb. and had to be lifted from a supply lighter to the vessel that laid them. To ease the stress on the cables and to reduce bending at the point where they passed overboard, the cables were led over parallel rollers at the launching side of the cable-laying barge—see Fig. 5, page 118. Furthermore, as shown in Fig. 6 on the same page, the two cables were suspended and directed by two other guide rollers—the upper roller being in two sections and the lower one in one section—which were hung from the craft's derrick. This contrivance made it comparatively easy to direct the cables continually downward toward the trench even when the scow was forced by the strong currents 10ft. or 15ft. off the correct line. Before any two cables were laid, their free ends were secured to their designed shore anchorages or terminal points.

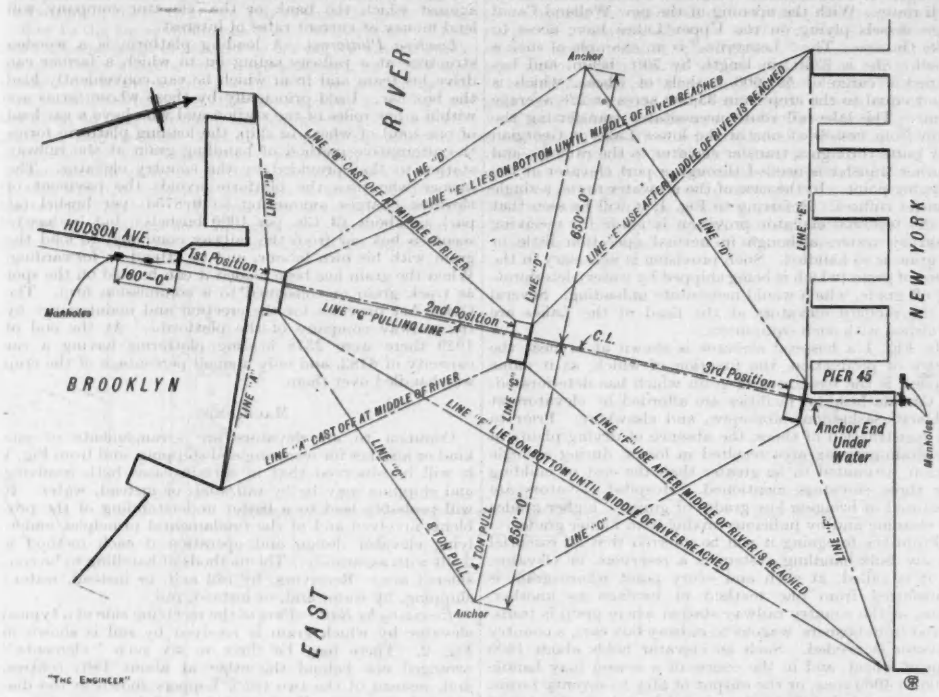


FIG. 1—METHOD OF CENTERING CABLE-LAYING BARGE OVER TRENCH

Traffic up and down the East River is heavy, and the Brooklyn Navy Yard, the most important Atlantic base of the U.S. Navy, is just beyond the cable crossing. Accordingly, every precaution had to be taken to avoid interfering with the free movement of vessels using the river. Tugs were stationed above and below the cable-laying barge for the purpose of warning craft and directing them how to approach and to pass the barge without striking any of the numerous control lines. When necessary, the barge could be held in place and certain of the lines slackened so as to leave a free course for ships of deep draught. Despite troublesome conditions, most of the cables were dropped directly into the trench, and only at a few points did they miss it by a narrow margin. At such points it was possible to pull them easily into their designed positions.

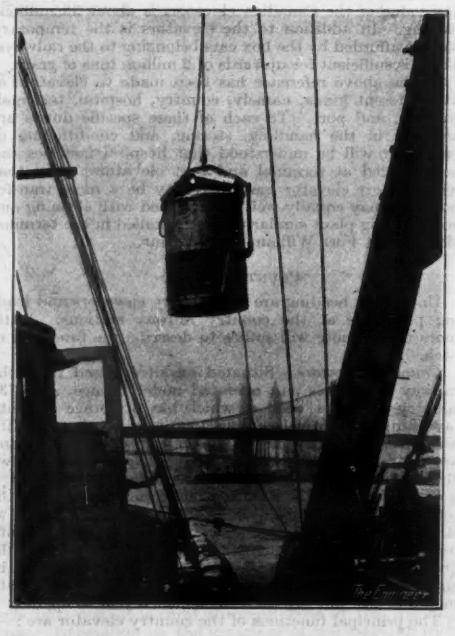


FIG. 2—BUCKET FOR BACKFILLING TRENCH

The rock trench was about 800ft. in length, and when the cables had been laid, the contractor had to backfill the trench with concrete and thus encase the cables. The method employed in placing the concrete was determined after careful consideration of all the factors involved. First, the concrete could not be dropped from any considerable height above the trench lest it should be swept beyond the trench by the strong currents or cause damage to the cables by impact. Finally, it was decided to use special Blaw-Knox concrete buckets of the "twin-bail" bottom-discharging type—see Fig. 2. Each bucket had a capacity of 2 cubic yards and was provided with means permitting close control during discharging. The buckets were opened by a line, secured to one of the twin bails, the opening being effected when the buckets reached the prescribed depth and were in the right position over the trench. The buckets were loaded from a mixing plant on shore and ferried out to the lighter that placed the concrete. The backfilling of the rock trench was carried out satisfactorily and with reasonable rapidity, all operations on the entire undertaking going forward twenty-four hours a day when once in full swing.

Because the vessel carrying the cables could not get closer than 150ft. from the Brooklyn shore, the cable ends at that side of the East River were landed by means of steel lines that were threaded through a waterside duct, the lines being wound in upon a winch on a truck that was backed up to a manhole near the shore. The cable ends were provided with special pulling eyes to facilitate this work. In the case of the oil-filled cables, each spool carried an oil reservoir connected to the inner end of the cable and, while these cables were being laid, positive oil pressure was maintained by an oil-filling-and-treating truck stationed for that purpose at the Brooklyn manhole. This precaution prevented any loss of pressure in the cables by temperature changes during the laying operations. The oil-filled cables are the first of that type laid under water in the New York area, and the electric companies concerned are, therefore, making a direct comparison under identical conditions between them and solid cables.

Upon reaching the New York shore, the cables had to be drawn into an open trench and thence up a manhole, making a right-angle bend before being connected to the corresponding land cable. Preparatory to effecting this transfer from the cable-laying lighter, a second barge was moored alongside and upon its deck the cable lengths still remaining on the two spools were unwound and coiled in the form of a figure 8 and the free ends made ready for pulling ashore. The cables were successively transferred from one barge to the other over a large sheave hanging from the derrick of the cable-laying vessel. A winch truck at the manhole on shore drew each cable in turn through the trench and up to the top of the manhole—a cable reel at the bend serving as a guide. Before an oil-filled cable was landed, the oil reservoir in the spool was disconnected and the cable end was made ready for pulling. After each cable of this type was landed, a temporary oil reservoir was attached and remained in service until the cable was permanently secured to its associated land cable.

On the New York side of the river, at Jackson-street, the cables are being connected to from ten to twelve auto-transformers. Each cable from Brooklyn will connect, by means of a pot head, with the high-voltage side of a transformer, and two 13·8 kV feeders—T.C. 600,000 c.m. lead-covered cables—connect to the opposite or low-voltage side, also through pot heads, and then to the 13,200-volt network of the Manhattan distributing system. The transformers are, in effect, small sub-stations in themselves, switching gear, potential and current transformers, automatic locking devices, &c., being contained within the transformer. The transformers have been supplied by the Westinghouse Company and the General Electric Company. The Westinghouse transformers are each 11ft. by 14ft. by 16ft. high, and each weighs without oil 56,500 lb. The oil increases this weight by 32,000 lb. The transformers built by the General Electric Company are of about the same size.

The laying of the fourteen cables on the bed of the East River at the point chosen was resorted to because, when the undertaking was planned, there was no tunnel available for the purpose. Ordinarily, such power cables are carried in the subaqueous transit tunnels, which are to be preferred for a number of reasons.

Handling and Storing of Grain;

WITH SPECIAL REFERENCE TO CANADIAN METHODS.*

By H. H. BROUGHTON, M.I. Mech. E.

IN a small country it is not easy to visualise the transport problems which have to be solved in other and much larger countries. One of these problems, in which we are all vitally interested, is that of ensuring the presence of our daily bread on the breakfast table. In the struggle to pay the baker, few have the time or the inclination to consider the means whereby the wheat of which the bread is made comes from the ends of the earth into this country at the rate of about 120,000 tons per week. Nevertheless, it is well to remember that if the machinery responsible for such movement failed from any cause for a time reckoned in weeks, famine would inevitably result, because Britain, although the largest importer of wheat, has safe storage accommodation for only a small fraction

* Paper read before the Institution of Mechanical Engineers on Friday, January 27th. Abstract.

of the wheat she consumes. An inexpensive remedy is advocated. On the basis of 5·7 bushels per head, excluding seed requirements, our population of 49 millions needs 280 million bushels of wheat per year, of which 40 million bushels are home-grown and 240 million bushels, or 6·4 million tons, are imported. The imported wheat comes to us chiefly from Canada, Australia, Argentina, the United States, and Russia, all of which countries compete for the business.

The Problem.

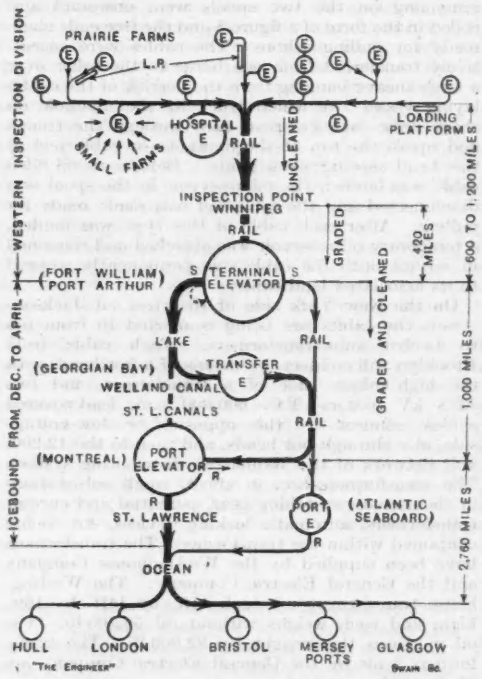
The problem in Canada is that of collecting uncleaned wheat from a quarter of a million small farms, in the Prairie Provinces and, after inspecting, grading, weighing, cleaning, and conditioning at one or more convenient centres, transporting this "hall-marked" wheat to the shipping point, which may be 2000 miles distant from the farm.

Contrary to a popular impression, the prairie farm only averages about 320 acres, of which not more than 150 acres are likely to be under wheat at one time. From such an acreage a yield of 2500 bushels is to be expected. The average capacity of a railway wagon, or box car as it is called, is 1300 bushels of wheat, so that the yield from the average farm is not likely to exceed two car loads. For some years the total area under wheat has amounted to 25 million acres. Accustomed as we are to thinking in millions, the habit is not one to be encouraged. It therefore suffices to state that the wheat fields of Canada are to-day represented by a rectangular strip of land having a length sufficient to girdle the earth at the Equator and a width of 1¼ miles. The vast acreage already under cultivation leaves 80 per cent. of the arable land in the three prairie provinces to be developed.

Production and Crop Movement.—Sowing takes place as soon as the condition of the ground will permit, which is usually about the beginning of May; but the actual date depends on the severity of the winter, and sowing time may be regarded as the three weeks from April 20th to May 10th. Most of the wheat is harvested during the month from August 10th to September 10th. Between the time of harvesting and the close of Lake navigation, as much of the crop as possible is moved to the terminal for cleaning and for shipment, and as a rule about 70 per cent. of the crop has been shipped out of the terminal before navigation closes.

Elevator System of Handling.

Part of the grain movement to the Atlantic seaboard is shown diagrammatically in Fig. 1. There are other



Grain is sampled for grade, condition, and dockage at the inspection point, and for grade at S, and, if desired, at R. E, country elevator; L.P., loading platform.

FIG. 1—ELEVATOR SYSTEM OF GRAIN HANDLING

outlets at Vancouver and Prince Rupert on the Pacific coast; at Churchill on Hudson Bay, and through the United States; but, since the method of handling is common to all outlets, it is thought that the diagram suffices to illustrate the principle of the movement.

From the prairie farm uncleaned grain in bulk is carted in small lots of 50 to 300 bushels by road—a distance of 1 to 20 miles—to the railway station, where it is received into a country elevator, or, to a limited, extent, is loaded direct into a railway box car over a loading platform. Grain is spouted from the elevator into box cars, and the latter, when loaded, are sealed by the railway agent to minimise the risk of theft in transit. Train loads of grain averaging sixty box cars or 2100 tons of wheat per train, move east literally by the thousand to the inspection point at Winnipeg. The car seals are first examined and then broken; the grain is sampled, inspected, and graded; and the cars, after being resealed, are assembled into trains averaging forty-three cars and dispatched to one of the terminal elevators at Fort William–Port Arthur at the head of Lake Superior. On arrival, the car seals are inspected before breaking, the grain doors are removed, and the grain is examined, weighed, cleaned, conditioned, and taken into storage by the elevator. Unless ordered to be specially binned, all grain of the same grade is stored in bins common to the grade.

Between them the terminal elevators at Fort William–Port Arthur have received no less than 100,000 tons of wheat in a day, and have shipped 170,000 tons in the same time.

Two outlets from the terminal elevator for cleaned and graded wheat are shown in the diagram, Fig. 1. One of these is the all-rail route to the Atlantic seaboard, which has to be followed in the winter and early spring when the Lakes and St. Lawrence waterway are icebound. The other outlet, through which most of the grain passes, furnishes two alternative routes, one route—lake and rail—being used by the largest vessels which ply on the Great Lakes; and the other, all water across the Lakes through the St. Lawrence canals, is restricted to vessels of smaller tonnage. A considerable volume of traffic is carried by each route. With the opening of the new Welland Canal large vessels plying on the Upper Lakes have acess to Lake Ontario. The "Lemoyne" is an example of such a vessel. She is 633ft. in length by 70ft. beam, and has carried a cargo of 551,000 bushels of wheat, which is about equal to the crop from 33,000 acres or 220 average farms. The lake-rail route necessitates transferring the grain from vessels at one of the lower Lake or Georgian Bay ports through a transfer elevator to the railway, and another transfer is needed through a port elevator at the shipping point. In the case of the all-water route, a single transfer suffices. Referring to Fig. 1, it will be seen that at the terminal elevator provision is made for receiving grain by water, although in normal operation little or no grain is so handled. Such provision is necessary in the event of grain (which is being shipped by water) deteriorating off grade, which would necessitate unloading. Several of the modern elevators at the head of the Lakes are furnished with such equipment.

In Fig. 1 a hospital elevator is shown at or near the centre of production, the function of which, as it name implies, is the treatment of grain which has deteriorated. In Canada hospital facilities are afforded by elevators at Calgary, Saskatoon, Moosejaw, and elsewhere. Prior to the construction of these, the absence of drying plants in the grain-growing area resulted in losses, during a single season, estimated to be greater than the cost of building the three elevators mentioned. Hospital elevators are also used in bringing low grades of grain to higher grades by cleaning and by judicious mixing with higher grades.

From the foregoing it will be inferred that an essential in any bulk-handling system is a reservoir, or elevator, as it is called, at each and every point where grain is transferred from one method of haulage to another. Thus, at the country railway station where grain is transferred from farmers' wagons to railway box cars, a country elevator is needed. Such an elevator holds about 1000 tons of wheat, and in the course of a season may handle 3000 to 4000 tons, or the output of fifty to seventy farms. The terminal elevator in turn is fed by a large number of country elevators, and considerable storage capacity is required. Movement down the Lakes before closing of navigation necessitates ample storage facilities at the transfer points from which grain is forwarded by rail to the Atlantic seaboard during the winter months. In virtue of the system of handling and storing that has been developed, "the torrent of the wheat harvest is guided and flows as freely and surely to the seaboard as the waters of a river to the sea."

In 1931 the total storage capacity of the licensed Canadian elevators was 415 million bushels, or, if all the space be devoted to the storage of wheat, a storage capacity sufficient for 11 million tons. Of this vast storage the country elevators in the prairie provinces account for 193 million bushels and the Ontario terminal elevators 94 million bushels. On a conservative basis the present-day value of the Canadian elevators is about 33 millions sterling. In addition to the elevators is the temporary storage afforded by the box cars belonging to the railways, which is sufficient for upwards of 2 million tons of grain.

In the above reference has been made to elevators of five different kinds, namely, country, hospital, terminal, transfer, and port. To each of these specific duties are assigned in the handling, storing, and conditioning of grain. It will be understood that hospital facilities can be provided at terminal and port elevators; also that while a port elevator may in reality be a mere transfer house, it may equally well be furnished with cleaning and conditioning plant similar to that installed in the terminal elevators at Fort William–Port Arthur.

Country Plants.

Under this heading are the country elevators and loading platforms at the country railway stations. Little more than a note will suffice to describe the functions of each.

Country Elevators.—Situated on sites leased from the railway companies and operated under licence, are 5734 country elevators, each of which has a storage capacity (average) of slightly less than 1000 tons of wheat. With few exceptions they are of timber crib construction and are equipped with scales, receiving hopper, one or two elevator legs, distributing and shipping spouts, and a number of bins. They serve as collecting stations for the terminal elevator and are of little interest, either as structures or from a mechanical engineering standpoint; but, collectively, they represent an investment by the grain trade of about 10 millions sterling spread over the entire wheat belt. Managed economically they are estimated to cost not less than £3,000,000 a year to operate.

The principal functions of the country elevator are:—

(*a*) To serve as a grain reservoir between the farm and the railway, which alone makes it possible to move the grain expeditiously and economically.
(*b*) To facilitate the financing of the crops.
(*c*) To preserve the grain in good condition and without loss.

When an independent farmer delivers his wagon or truck load of grain—perhaps 50 to 300 bushels—at the country elevator, he may either sell it outright or he may place it into storage in one of three ways:—(1) According to grade agreed upon with the elevator operator; (2) in special bins; and (3) subject to inspector's grade and dockage.

Storage according to grade agreed upon is the simplest and most common method of storage. The grain after being weighed is stored in a bin containing grain of the same kind and grade. Storage in special bins can only be obtained by arrangement with the elevator operator. While the method preserves the identity of car load lots of grain till they can be officially inspected at the inspection point, it is liable to give rise to a large volume of dead storage in the elevator. In lieu of special binning, the method of storing known as "subject to inspector's grade and dockage" has been adopted by a number of elevator companies. It permits the storage of grain under a grade and dockage established by examination of a sample by the Chief Inspector in Winnipeg.

Grain sold to a country elevator is paid for by a "cash purchase ticket" which is cashed for the farmer either by a bank or by the elevator company's agent. A farmer putting grain into storage in a country elevator is given a storage ticket which constitutes good collateral security against which the bank or the elevator company will lend money at current rates of interest.

Loading Platforms.—A loading platform is a wooden structure at a railway siding on to which a farmer can drive his team and from which he can conveniently load the box car. Used principally by those whose farms are within a few miles of the station and who have a car load of one kind of wheat to ship, the loading platform forms the alternative method of handling grain at the railway station to that provided by the country elevator. The farmer who uses the platform avoids the payment of elevator charges amounting to 0·875d. per bushel (at par), or about £3 13s. per 1000 bushels; but he has to secure a box car from the railway company, to load the grain with his own labour, and to attend to forwarding. When the grain has been loaded it can be sold on the spot as track grain or consigned to a commission firm. The Grain Act provides for the erection and maintenance by the railway company of the platforms. At the end of 1929 there were 2578 loading platforms having a car capacity of 6183, and only a small percentage of the crop was handled over them.

Machinery.

Common to all elevators are arrangements of one kind or another for receiving and shipping, and from Fig. 1 it will be observed that in certain cases both receiving and shipping may be by rail, and, or instead, water. It will probably lead to a better understanding of the problems involved and of the fundamental principles underlying elevator design and operation if each method is dealt with separately. The methods of handling to be considered are:—Receiving, by rail and, or instead, water; shipping, by water and, or instead, rail.

Receiving by Rail.—Part of the receiving side of a typical elevator by which grain is received by rail is shown in Fig. 2. There may be three to six such "elements" arranged one behind the other at about 48ft. centres, and, instead of the two track hoppers shown in the diagram, there are usually three to five such hoppers tributary to each receiving belt. A train of loaded and sealed box cars on its arrival at the terminal is shunted on to the elevator siding and the cars are "spotted" over the gratings of the track hoppers by an electrically driven winch known as a car puller. The door seals are examined before the doors are opened, and if for any reason the grain in a car has not been inspected and graded this work is now done by the inspection Department's representative stationed at the elevator. To make it impossible to mix the contents of different car loads, all the track hopper valves are fitted with interlocking gear, so that only one hopper per belt can be emptied at a time. When the entire car load of grain has been unloaded into the track hopper the valve is opened, and, by belt conveyor, bucket elevator, and fixed spout, the grain is conveyed, elevated, and discharged into the garner immediately above the scale. During this operation, which may take three to ten minutes, depending on the capacity of the car and leg, the garner valve is kept closed till the entire draft has been elevated. The grain is next transferred to the scale hopper and weighed, after which it is distributed as desired to any part of the elevator by means of a turn-head which discharges into fixed and movable spouts, and on to conveyor belts. Fig. 2 shows the grain being placed into storage by means of fixed spout, belt loader, conveyor belt, and tripper. Equally well the grain can be distributed by means of Mayo spouts to bins in the working house, which are tributary to and feed by gravity the cleaning and conditioning machinery to which reference is made elsewhere in the paper.

In a well-designed plant it is possible, without re-elevating, to discharge the grain into any bin in the working house or storage. Actually the receiving leg depicted in Fig. 2 is arranged to discharge (1) through direct spouting to (*a*) two (or three) Mayo spouts, (*b*) two shipping bins, (*c*) the reversible transfer belt, (*d*) one (or two) belts over the storage bins; and (2) through a Mayo spout to another storage belt. The reversible transfer belt, which passes longitudinally through the working house, from end to end, is provided with a four-pulley tripper and with travelling belt loaders. Each of the Mayo spouts discharges into a large number of bins in the working house.

Unloading of box cars into the track hoppers is usually effected by power shovels. A power shovel consists of a large two-handled scoop attached to a rope which is coiled on a drum mounted on a rotating shaft. The mechanism is arranged in such a way that the shoveller is free to move in the car with the shovel, but the moment he stops the rope coils on the drum, and in so doing drags the shovel full of grain to the car door. With two of these appliances in operation it takes about half an hour for two shovellers to unload and clean up a car containing 55 tons of wheat. During the last eight or ten years mechanical unloading appliances, called car dumpers or unloaders, have been introduced, and these expedite unloading and at the same time eliminate the work of the shoveller. Four such dumpers instal.ed in an elevator at Montreal have a combined unloading capacity of 25,000 tons per day. Under ordinary working conditions a dumper can be relied upon to unload a car in six to eight minutes. The most recent development is to unload the cars by shaking them. The reciprocating motion is applied to the clamped and slightly tilted car as soon as the flow of grain through the opened door has ceased, and the grain remaining in the car is rapidly shaken out. Dumpers of this kind have the important advantage over other types of being readily installed in existing elevators without costly structural alterations.

Receiving by Water.—Grain received by water is unloaded by counterweighted bucket elevators, called

marine legs, which can be accurately positioned over the hatchways and lowered into the holds of the vessel to be discharged. On the dip or run down into the hold such a leg will elevate 22,000 to 25,000 bushels per hour. The marine leg is housed in and controlled from a portable marine tower in which the grain is weighed before it is loaded on to the conveyor belt leading to the storage bins. The marine tower is about 150ft. high and complete with leg weighs 550 to 600 tons. For positioning, the tower can be slowly moved along the quay, the usual travelling speed being 10ft. per minute. Several of the large transfer elevators have three marine towers.

In practice, the boot of the marine leg rapidly sinks to the bottom of the hold, and in a short time the grain ceases to flow to the leg as quickly as it can be elevated. When this happens, grain is brought to the leg by mechanically operated ship shovels, which are actuated by ropes and tackle from multiple-drum winches in the marine tower. Two shovels are used and they are rigged so as to dig into the grain as they approach the leg and to slide over the grain as they recede. The movement of the shovels is controlled by air valves which alternately engage and release friction clutches on the rope drums of the winch. In this way the output is maintained long after the leg has touched bottom. The operation is repeated until the bulk of the grain has been brought up to the leg, when the ship shovels are discarded. At this stage lighter and smaller clean-up shovels are brought into action, and a man on the deck who is watching the shovel man in the hold engages the clutch by means of a pull cord. The final cleaning up is done by sweepers and hand shovellers. As an instance of the rapidity of unloading Lake vessels by the method just described may be cited the discharging of a cargo of 503,412 bushels of wheat by means of two marine towers in 19¼ hours, which is equivalent to a continuous discharge of 25,820 bushels per hour.

Two arrangements of marine tower are illustrated diagrammatically in Fig. 3. Of these, the main diagram shows the lofter leg in the tower discharging on to a conveyor belt over the nearby storage house. Many such towers are used in the transfer elevators at the Georgian Bay ports, where grain is transferred from Lake boats to railway box cars. The equipment of a large marine tower of this type consists of a 25,000-bushel marine leg driven by a 100 H.P. motor, and furnished with motors of 30 H.P. and 10 H.P. for lifting and positioning and with a 20 H.P. motor for operating the ship shovels. The tower is 164ft. high above quay level, and is provided with a 25 H.P. motor for travelling. The leg, 105ft. between centres, is equipped with two staggered rows of 13in. buckets bolted to a seven-ply belt at 12in. centres. Grain is delivered through a hinged telescopic spout and an apron spout to a garner above the scale, which, in turn, discharges to a garner immediately below. This lower garner feeds a lofter leg, of 152ft. centres, equipped with a double row of 18in. buckets, pitched at 12in., and driven by a 125 H.P. motor. The lofter leg distributes through a hopper and through travelling loaders to either of two 42in. belts from which the grain is tripped to one of a number of 42in. receiving belts over the storage bins.

The arrangement (*a*) shown by dotted lines in Fig. 3 feeds a conveyor belt which is housed in a tunnel in the quay, and which discharges into the boot of a receiving leg in the elevator. As the grain is weighed in the marine tower, it can be spouted direct into the storage bins without reweighing.

Shipping by Rail.—Part of the shipping side of an elevator is depicted in Fig. 4. Irrespective of the mode of shipment, the grain it is desired to ship is loaded on to a belt in the storage basement and conveyed to the boot of a shipping leg, the head end of which discharges into a garner immediately above a scale hopper fitted with a rotary valve. Below the hopper is a turnhead, the position of which can be varied according as the grain is to be put on rail, on board ship, or elsewhere. When the grain is to be loaded into box cars, it is weighed, in car load lots of 45 to 60 tons, and the turnhead discharges into a car spout, the lower bifucated end of which is flexible and is manipulated by block and tackle. The end of the spout is placed in the car and, as quickly as the scale hopper can empty and a column of grain can fall vertically 80ft. or more under the action of gravity, the car is loaded. By using a bifurcated spout, loading takes place simultaneously from both ends of the car, and the grain is self-trimming. Including the time required for shunting, it takes less than six minutes to load a 60-ton box car. Samples for grade are drawn by the inspectors as the grain is moving. Depending on the size of the elevator, the shipping facilities may consist of as many as six such legs and associated equipment.

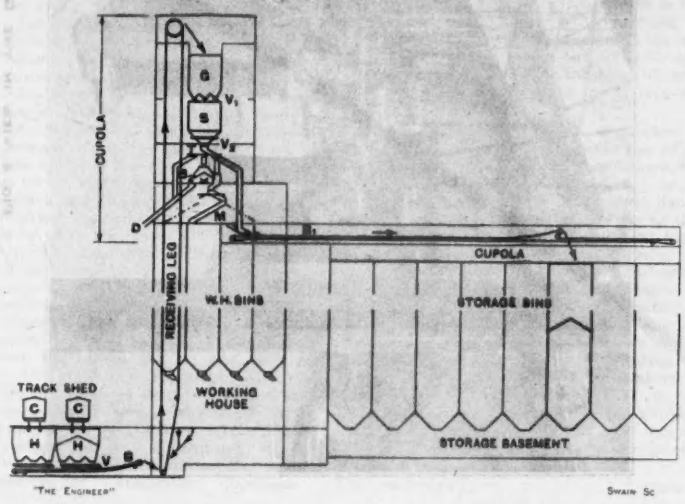
Shipping by Water.—The grain is weighed as before, but the draft is now only limited by the capacity of the scale, and the turnhead discharges into a spout which feeds into one of several shipping bins in the working house. Depending on the situation of the elevator with respect to the quay, the shipping bins (*a*) discharge on to several wide belts, which convey the grain to vessels berthed some distance from the elevator, as shown in Fig. 5, or (*b*) feed direct into telescopic dock spouts positioned over the hatchways of the vessel taking in grain. Four 36in. belts loaded to capacity can handle about 1900 tons per hour, but trimming of the grain in the holds lowers this rate. At Montreal a vessel took on board 7360 tons of wheat in 6¼ hours, which corresponds to a maintained average rate of 1178 tons an hour. During the earlier part of the run grain was loaded at the rate of 1875 tons an hour. When the shipping bins feed direct into dock spouts the maximum rate of loading with 20in. spouts is 800 tons an hour per spout, and vessels can be loaded at the rate of 3000 tons per hour. One of the large Lake vessels has taken on board a cargo of 550,000 bushels, or 14,800 tons, of wheat in five hours. In a typical elevator there may be twelve to fifteen shipping bins having a combined capacity of 4000 to 5000 tons.

Cleaning.—Grain as received at the terminal elevator is more or less polluted by admixtures of various kinds, and all grain on which the inspector has set dockage must be cleaned to grade excepting "rejected" and "no grade" grain, which is cleaned only at the owner's request. At the inspection point the dockage is determined by means of sieves of legal size mesh. In the cleaning of grain at the terminals, the screens used in the machines for removing the dockage are of the same mesh as those used by the inspectors in setting the dockage; but to expedite the cleaning process other intermediate screens and air separations are employed.

One of the most widely used receiving cleaners is the "Monitor." In this machine the light impurities, dust, and immature grains are first removed by air separation. The coarse refuse is then taken out by a roughing screen, through which the partially cleaned grain passes to the main cleaning screen. From the lower end of this screen is discharged everything larger than the kernels, while the grain itself passes through the holes in the screen on to a third finely perforated screen. The function of this screen is to remove fine dirt, cockle, and seeds, all of which pass through the screen while the grain travels over its surface. Finally, the grain is subjected to a second air cleaning, after which it is discharged and spouted to a leg for elevating. Th head of this cleaner leg is generally equipped with an enclosed three-way turnhead, by means of which the grain can be discharged (*a*) to either of two garners and weighed, or (*b*) direct to a telescopic distributing spout on the bin floor.

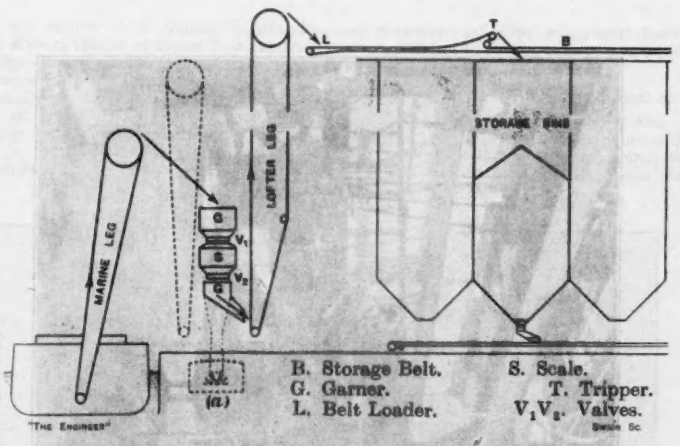
As a rule, the cleaners are situated on the ground floor of the working house in batteries of two to four machines. Each battery is tributary to a cleaner leg, and is fed through fixed spouts by from two to six bins in the working house. Machinery of capacity sufficient to clean the grain as quickly as it is received is the ideal to be aimed at in designing and equipping the cleaning department of a terminal elevator; but in practice it is not an unusual occurrence for the cleaners to be continuously at work on a seven-day week, because the amount of cleaning to be done varies between wide limits from year to year.

The by-products of cleaning, namely, the screenings, "tailings," and dust, are of commercial value, chiefly on account of the whole and broken grain they contain, and it is necessary briefly to indicate the course followed by each of these in a typical elevator. The screenings are discharged from the cleaning machines to a screw conveyor and leg which feed one or more screenings separators on the distributing floor in the cupola of the working house. These machines, in turn, discharge to a double disc separator, the first unit of which separates the wheat from the oats, and the second unit the seeds. In like manner, the tailings, after being passed over a rough screen to remove the straw, are fed to a machine which reclaims the grain from the unthreshed oats and which discharges to a disc separator for separating the wheat and oats. The air-borne dust from the cleaning machines passes to



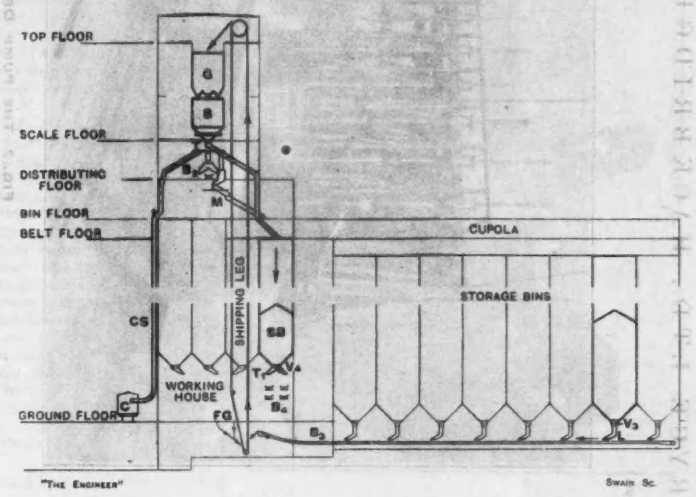
B Receiving Belt, 36in. to 48in. wide.
B_1 Storage Belt, 36in. to 48in. wide.
B_2 Transfer Belt, 36in. to 48in. wide.
C Box Cars, 45 to 60 tons capacity.
D Dryer Spout.
G Garner, 2500 to 3000 bushels.
H Track Hopper, 2500 to 3000 bushels.
L Belt Loader.
M Mayo Spout.
S Scale Hopper, 2000 to 2500 bushels.
T Turnhead.
V Track Hopper Valve
V_1 Garner Valve.
V_2 Scale Hopper Valve.

FIG. 2—RECEIVING BY RAIL



B. Storage Belt.
G. Garner.
L. Belt Loader.
S. Scale.
T. Tripper.
V_1V_2. Valves.

FIG. 3—RECEIVING BY WATER



B_2 Transfer Belt, 36in. to 42in. wide.
B_3 Basement Belt, 36in. to 42in. wide.
B_1 Shipping Belt, 36in. to 42in. wide.
C Box Car, 45 to 60 tons capacity.
C S Car Spout, 12in. diameter.
F G Floor Gratings, 2ft. 6in. to 3ft. square.
G Garner, 2500 to 3000 bushels.
L Belt Loader. [radius,
M Mayo Spout, 14in. to 20in. dia., 18ft.
S Scale Hopper, 2000 to 2500 bushels.
S B Shipping Bin.
TT_1 Turnheads.
V_3 Storage Bin Valve.
V_4 Shipping Bin Valve.

FIG. 4—SHIPPING SIDE OF ELEVATOR

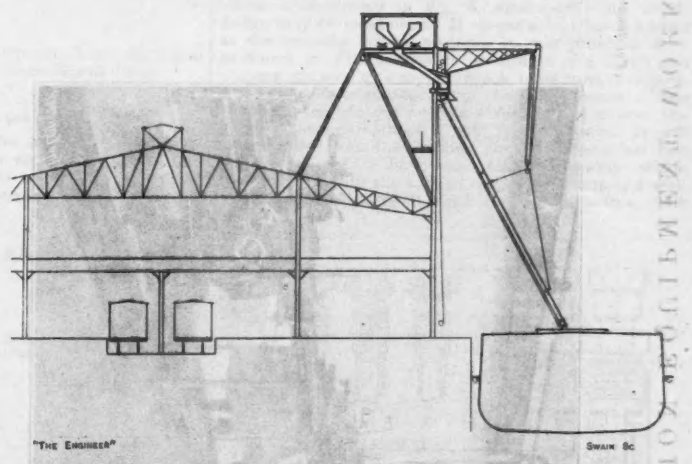


FIG. 5—JETTY SHOWING TRANSIT SHED, BELT GALLERY AND DOCK SPOUT

FUEL INJECTION EQUIPMENT WORKS OF BRYCE LTD., HACKBRIDGE, SURREY

(*For description see opposite page.*)

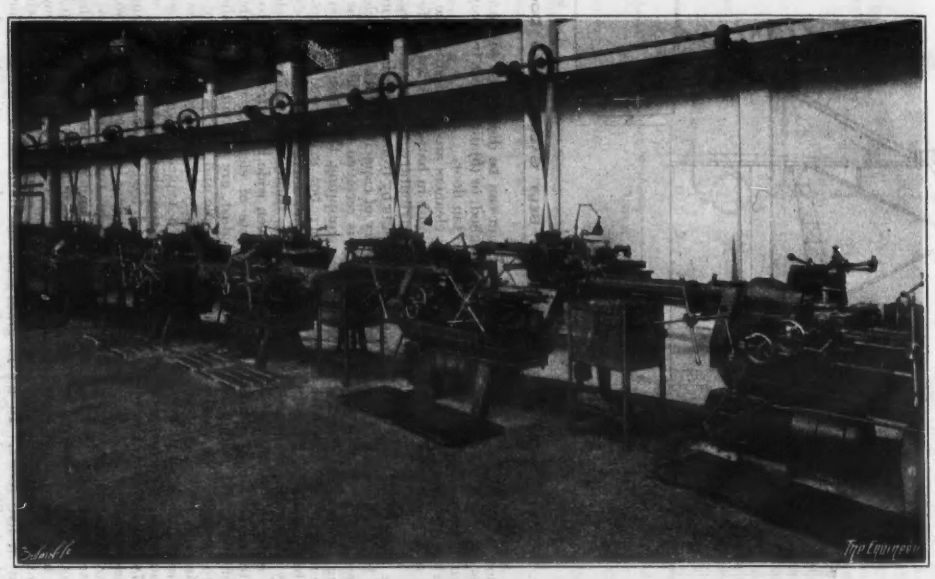


FIG. 1—THE CAPSTAN LATHE DEPARTMENT

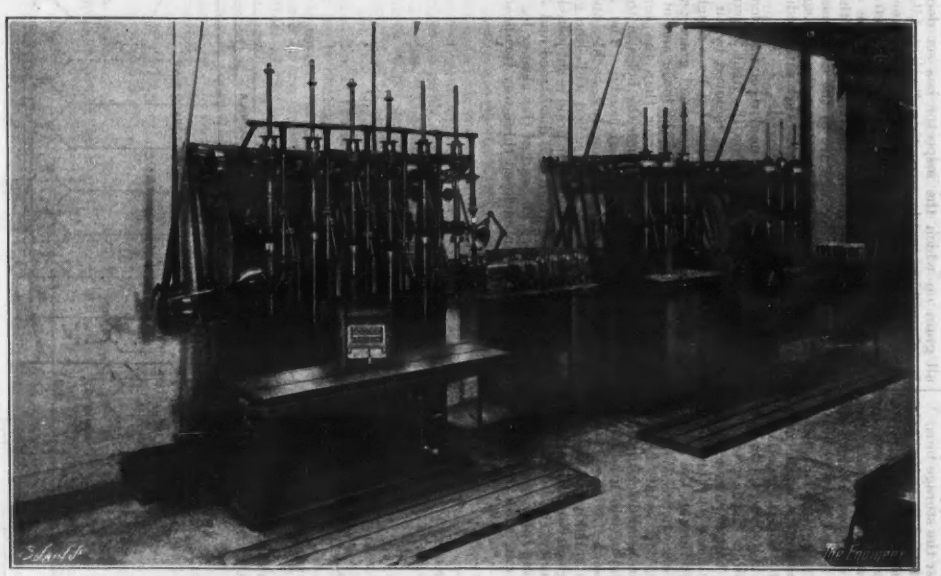


FIG. 2—THE PUMP DRILLING MACHINES

FIG. 3—VIEW IN THE MILLING SECTION

FIG. 4—VIEW IN THE GRINDING SECTION

cyclones outside the elevator and is removed by a fan which discharges into another cyclone on the bin floor above the screenings bin or on the roof of a dust house remote from the elevator.

In the above only one method of cleaning as applied to wheat has been described. It will, however, be understood that many methods of cleaning and conditioning are practised; also that many different kinds of grain, all requiring treatment of one sort or another, are handled.

Drying.—In some seasons a high percentage of the crop may have to be dried prior to shipment. Grain inspected as "no grade" for moisture and dried, may be graded as dried of the grade to which it belongs or as "straight" grade, in the discretion of the inspector. The drying plants now installed in many of the terminal and port elevators have a combined rating of 1450 tons of wheat an hour. The dryer is housed in a reinforced concrete building adjoining the working house of the elevator. A large garner above the dryer receives grain direct from the cupola either by belt conveyor or by spout, and the dried grain is spouted to the boot of a dryer leg situated in the basement of the working house. This leg discharges to a garner and scale or through a telescopic spout to one of a number of bins. In operation air, drawn by fan through the cooling chamber of the dryer, is passed over a battery of steam-heated pipes into the drying chamber which contains the damp grain. Such machines are designed to operate on continuous feed or on the batch principle. They are usually constructed on the unit plan and arranged so that they may be worked separately or in concert.

Electric Equipment.—The electric supply is three-phase alternating current, and is usually obtained from an outside source on the maximum demand system with a penalty for low power factor. As a rule electric energy costs less than 1d. per unit, and, under favourable conditions of maximum demand and consumption, prices in the neighbourhood of ¼d. per unit have been obtained. Current consumption is governed by the character of the elevator, but for a modern cleaning house handling a large volume of business and shipping grain by direct spouting, the consumption is not likely to exceed 0·85 kilowatt-hour per ton of grain handled. The incoming high-tension supply is transformed down to about 550 volts for power and to 110 volts or 110/220 volts for lighting and signals. In most cases a continuous rating of 50 to 60 per cent. of the combined ratings of the whole of the motors installed suffices for the power transformers. The many feeder circuits for the elevator are brought to a main distribution board in the sub-station, and each of these circuits is provided with an oil-immersed circuit breaker fitted with overload and no-voltage protection. On the North American Continent, industrial electrical installations comply with the National Electric Code, and machinery, switchgear, control equipment, fittings, and wiring are covered by the specification. In the Code grain elevators come under "Hazardous Locations." The explosive nature of grain dust is recognised, and the electrical work is carried out accordingly.

At one time large synchronous motors, used as synchronous condensers, were installed for improving the power factor of the load, and oil-immersed condensers have been extensively employed for the same purpose. The most recent practice is to use a number of self-starting synchronous motors for driving certain of the machinery, such as the receiving and shipping legs. Excited to give unity power factor at full load, these motors serve the dual purpose of driving the legs, and of improving the power factor of the entire installation. Associated with most of the legs are conveyor belts, taking grain to or from the legs, and driven by induction motors. Under the light load conditions which prevail when grain is not flowing, the power factor of the induction motors is very low, but under such conditions the synchronous motors have a leading power factor, the effect of which is to improve the character of the load.

Conveyor belts, small legs, car pullers, shovels, cleaning machines, and fans are driven by induction motors, which, practically without exception, are of the squirrel-cage type. When such a motor is required to start under heavy load, it is fitted with two squirrel-cage windings on the rotor, the combined effect of which gives the motor a high starting torque without excessive starting current and efficient operation under running conditions. Depending on their situation in the elevator, the motors may be of the totally enclosed, or pipe-ventilated or enclosed ventilated type, and the machines are usually fan cooled. In view of the difficulty and cost of making airtight joints in the trunking, and of ensuring a supply of clean air from outside, the use of pipe-ventilated motors is not recommended.

Minimising Explosion Hazard.—In the handling of grain large quantities of fine dust are liberated, which, under certain conditions, forms a highly explosive mixture in air. Ignition may be due to mechanical or electrical causes or to a naked flame. Research has resulted in a better understanding of the factors to be taken into consideration in order to lessen the risk of dangerous conditions arising. Briefly, designers endeavour to prevent serious explosions in an elevator by:—(1) Segregating the different units so as to confine any explosion that might occur to the unit in which it occurs; (2) efficient ventilation of buildings, bins, and machinery; (3) providing self-opening windows of large size in the buildings; (4) paying special attention to the design of the legs; (5) minimising accumulation of dust in the buildings; (6) continuous removal of dust from the buildings and machinery; (7) recognising the danger and designing the electrical equipment accordingly; (8) earthing all conveyor belts and other details liable to become charged with static electricity.

(*To be continued.*)

Bryce Fuel Injection Equipment.

In the article which follows we describe and illustrate the Kelvin Works of Bryce Ltd., of London-road, Hackbridge, Surrey, which have been specially designed and equipped with the most modern machine tools for the standard production of "Bryce" fuel injection equipment for all kinds of internal combustion engines. The fuel pump and injector manufactured were designed by Mr. A. A. Sidney, who, for many years, has been engaged in high-speed oil engine work connected with industrial engines, and those for road transport and aircraft. Although the actual standardised manufacture of pumps and injectors, which we saw on the occasion of a recent visit, was only begun at the end of last year, experimental and development work has been carried out for some time past, and we understand that several of the leading British oil engine firms which have tested Bryce fuel injection equipment have pronounced it to be equal to similar pumps and injectors of Continental design.

Lay-out of Machine Shop.

It is well known that, for the successful production of pumps and injectors of the type we describe, the highest accuracy in machining, which is only obtainable with modern machine tools, along with careful workmanship and rigid inspection, is an absolute necessity. The works have been laid out with this end in view. Four views in the main machine shop are reproduced opposite, This shop is a well-lighted building, 250ft. long and 50ft. wide, with provision for further extensions to it. It is kept at an even temperature by Sturtevant's ventilating plant. As will be seen from the engravings on page 114, the machines are so grouped that overhead cross belts are avoided as far as possible. Many of the machines are of the individual motor-driven pattern, and they are arranged alongside covered cable ducts in which the power cables are laid, thereby effecting a very neat arrangement with easy access to all electrical connections. Although there is an excellent north light from above with general shop lamps for illumination, in all cases each machine is further equipped with an adjustable lamp for the use of the individual operator.

Figs. 1 to 4 show typical views in the capstan lathe, drilling, milling and grinding sections. Besides the main machine shop, there are also separate shops for the manufacture and assembly of pump plungers, sleeves, and injectors, and for hardening, plating and spray-painting,

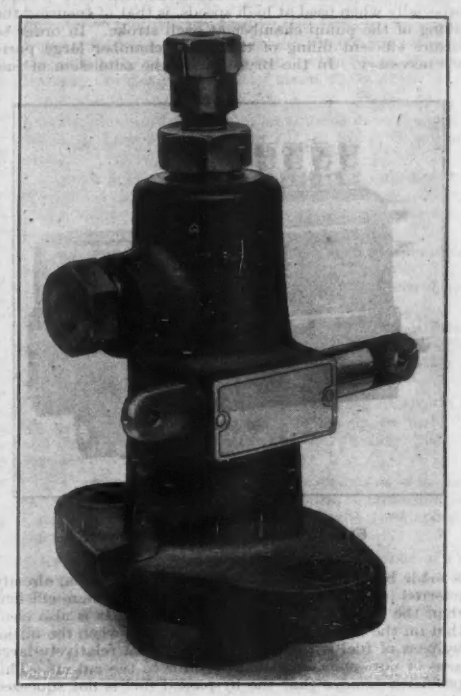


FIG. 7—SINGLE CYLINDER NON-CAMSHAFT PUMP

with the addition of a pump-testing shop and an experimental department for oil and petrol engine tests.

The Bryce Fuel Pump.

Before referring in further detail to the manufacture of the Bryce fuel pump, a typical six-cylinder unit of which is illustrated in Fig. 5, some particulars of its design may be mentioned. It operates on what is known as the constant stroke, variable by-pass principle, and, as shown in Fig. 6, consists essentially of a sleeve and plunger operated by a tappet, which, in its turn, is reciprocated by a cam and spring in the usual manner. The design of the plunger and its sleeve are, of course, the most important features of this type of pump. It will be observed from the drawing that the sleeve has two ports of triangular form—see enlarged drawing—which communicate with the suction side of the pump and with the bore of the sleeve in which the plunger works. The plunger is drilled along its axis and two cross holes are also drilled to pierce the axial hole. The lower of these cross holes communicates with an annular groove in the plunger. The pump utilises only the centre third of the stroke for injection, on the quickest part of the cam. The manner in which the fuel is by-passed is clearly shown in the small diagrams of the plunger, Nos. I., II., III. and

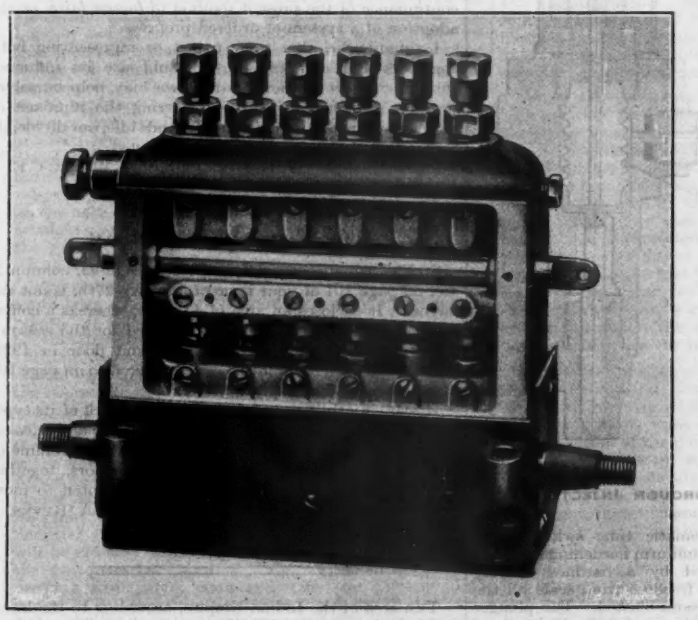


FIG. 5—SIX-CYLINDER CAMSHAFT TYPE PUMP

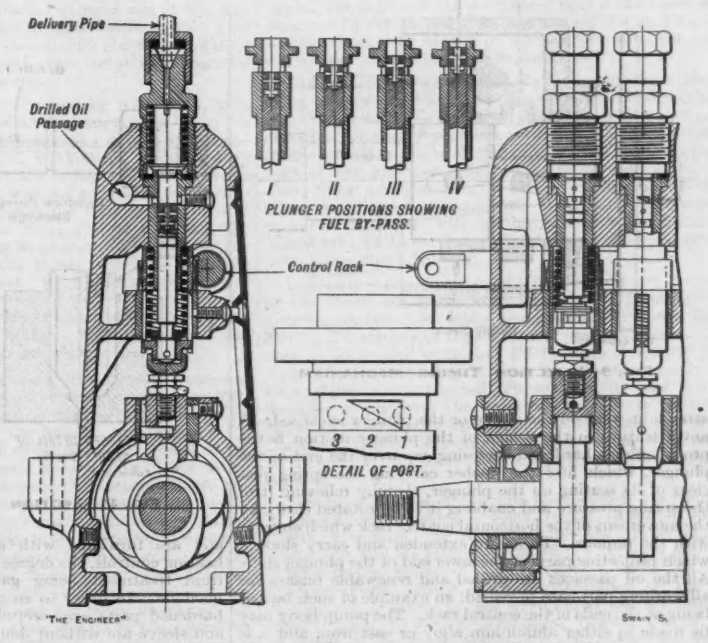


FIG. 6—SECTIONS THROUGH PUMP AND PLUNGERS

IV., reproduced in Fig. 6. In the fuel by-pass position of the pump the sequence of operations is as follows:—The first of these drawings illustrates the plunger at the bottom end of its stroke, the second in a rising position with the by-passing of fuel over the top of the plunger ending and beginning at the upper hole, the third with by-passing at the upper hole ending and beginning through the lower hole in the recess, and the fourth with the plunger at the upper or outer end of its stroke with full by-pass through the recess. The enlarged port drawing in the same illustration indicates three positions of the holes in relation to the triangular ports showing (1) full by-pass, (2) half by-pass, and (3) full delivery, the variation in fuel delivery being obtained by rotating the plunger in relation to the fixed triangular port in the sleeve.

One of the difficulties associated with fuel pumps, especially when used at high speeds, is that of ensuring the filling of the pump chamber at each stroke. In order to ensure efficient filling of the pump chamber large ports are necessary. In the Bryce pump the admission of fuel

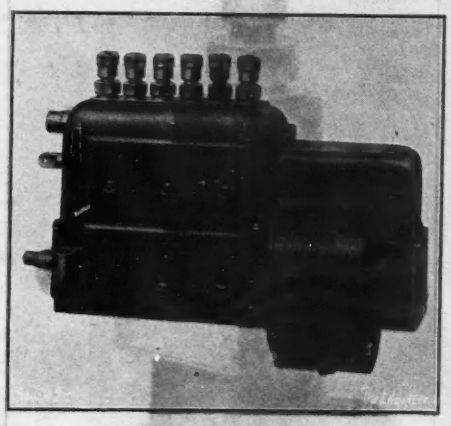


FIG. 8—PUMP WITH GOVERNOR

is made by the two triangular ports of large area, already referred to, which are claimed to be much more efficient than the usual drilled hole arrangement. It is also clear that on the upward stroke of the plunger, when the initial by-pass of fuel is taking place, there is a relatively large area of port open immediately prior to the cut-off. This provision ensures that the by-passed fuel is not squeezed past to the suction side of the pump at a high velocity. When a round hole port is utilised it is difficult to avoid a high terminal velocity of the by-passed oil, which may give rise to a danger of gassing the fuel. The very sudden cut-off given by the Bryce design gives, it is claimed, a good start to the injection stroke, while a good finish to the stroke is ensured by the use of double ports with their large and rapidly opened areas. There is no waste stroke on the outward travel of the plunger, as the delivery valve permits the passage of fuel to the injector immediately the valve is raised from its seat. The plunger is hydraulically balanced so that no side thrust with its

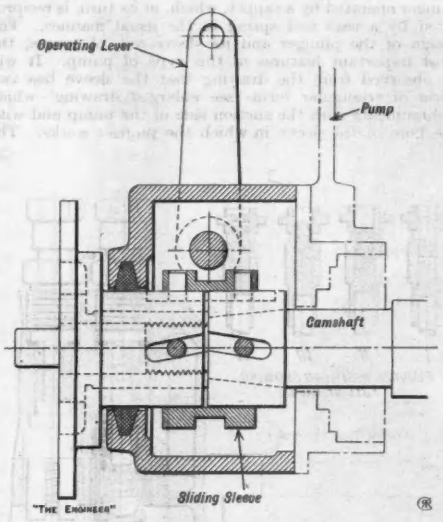


FIG. 9—INJECTION TIMING MECHANISM

attendant wear on the sleeve or the plunger is caused. A novel feature in the design of the plunger motion is the provision of a hardened enclosing cap over the end of the plunger, which lifts the washer carrying the spring just clear of its seating on the plunger, thereby relieving it of the spring pressure and enabling it to be rotated easily by the movement of the horizontal control rack which engages with the pinions. These are extended and carry slots in which projecting parts of the lower end of the plunger slide. All the oil passages are drilled and renewable bushes for all working parts are provided, an example of such bushes being at the ends of the control rack. The pump body may be made in either aluminium alloy or cast iron, and it is neat in design and smaller in size than other designs we have already described. Attention may be drawn to the closely spaced plunger centres. The dimensions of the lugs for attachment to the engine make the pump easily interchangeable with existing designs. Ready accessibility is given by a light door secured by three screws, which in Fig. 5 is shown removed, and which exposes the principal parts for inspection and the adjustment of tappets.

Bryce pumps are built in a standard range of sizes employing plungers from 0·2in. diameter up to 0·781in. diameter and with cam lifts of $\frac{1}{4}$, $\frac{3}{8}$, $\frac{11}{16}$, and $1\frac{1}{16}$, thereby covering a wide range of engine outputs. The pumps are, further, manufactured in one up to six-cylinder units, either with the complete cam shaft as illustrated in Figs. 5 and 6 or in cases in which engine builders prefer to supply their own cam shafts of the non-cam shaft pattern shown in Fig. 7. In Fig. 8 we show a six-cylinder cam shaft type pump with a governor which controls maximum and minimum engine speeds between which the throttle control takes charge of the pump. A timing control is also manufactured, which, as shown in Fig. 9, is of very simple design. It consists of a sliding sleeve moved by an operating lever which carries pins engaging with inclined slots milled in the couplings of the cam shaft and the driving plate extension. When the operating lever is moved the phase relation of the driving and driven shaft is altered, thereby varying the time of fuel injection and the delivery of the fuel to the cylinder.

BRYCE FUEL INJECTORS.

The firm also supplies standard injectors and filters Two of these injectors are illustrated in Fig. 10. The left-hand injector is designed to be interchangeable with other designs, while to the right the normal Bryce design is illustrated, which is only a little larger than the sparking plug illustrated alongside it. Fig. 11 shows a section

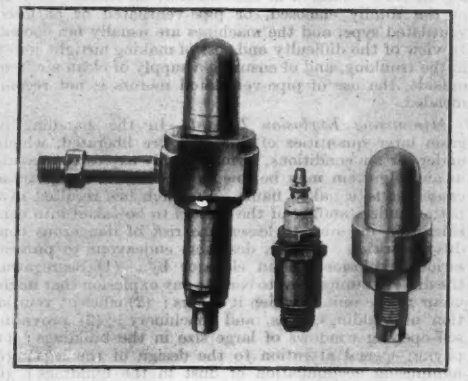


FIG. 10—INJECTORS AND SPARKING PLUG

through the injector, which is of the automatic type with a pintle extending through the fuel orifice. The oil is carried down the milled grooves at the sides of the needle and lifts it against the pressure exerted by a cylindrical corrugated diaphragm which effectively permits any leakage of fuel. The lift of the needle can be varied by means of an adjusting screw which is enclosed by a domed cover.

THE MANUFACTURING PROCESS.

In our inspection of the works we were impressed by the great care which is taken in the machining and finishing of the component parts. The principal small parts are first produced on high-speed capstan lathes with roller bearing spindles, after which they are ground to fine limits, irrespective of their being hardened or left soft, a practice which has been found to be necessary if the desired accuracy of dimension and finish is to be attained. The hardening furnaces we noted are electrically heated

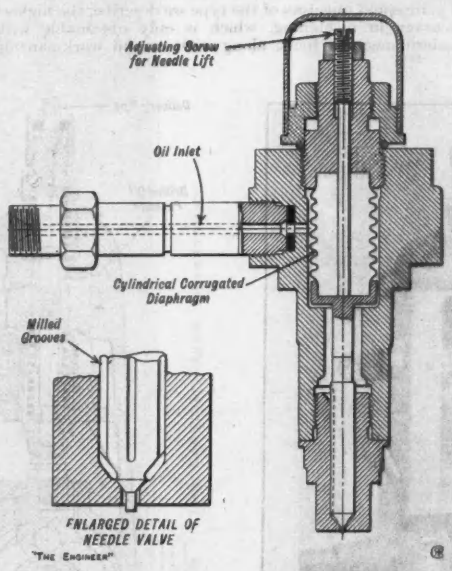


FIG. 11—SECTION THROUGH INJECTOR

and are furnished with automatic time switches and heating controls, the degree of uniform hardening resulting from treatment being gauged by a hardness testing machine. In order to ensure freedom from scale all the hardened parts are carefully sand-blasted. The plunger and sleeve are without doubt the most difficult details of the pump to produce. They, with the injectors, are manufactured in a separate department, the floor of which is treated with a special dressing in order to prevent any dust. This shop is also kept at a constant temperature. We were informed that in order to make the plunger of such a fit in the sleeve that it will pump oil against very high pressures a limit of plus or minus 0·00001in., both parallel and round, is necessary, while the hole in the sleeve and the outside diameter of the plunger must have an absolutely mirror finish, without a mark or a scratch. Another interesting operation is the cutting of the ports in the sleeves, which require very sharp corners and have to be finished to one-thousandth of an inch. For this operation it was found essential to design and build a special machine, which has reduced the machining time for cutting both ports to only one minute.

The various components are rigidly inspected after finishing machining, and before passing into the stores. From the stores they are issued to the assemblers, who put them together without using vices or without the aid of hammers or files, no hand fitting being required. From the assembling benches all the completed pumps go to the testing department and are tested at engine speed on a special machine. They are then numbered, and a record is kept of each pump before it passes into the finished stores for despatch.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

OIL-ELECTRIC LOCOMOTIVES.

SIR,—On the question of engine speed it is interesting to observe that if any engine design is either expanded or contracted in all its dimensions proportionately, then the bearing loads, per unit of area, remain constant if the piston speeds are the same.

This is simple and fundamental, but possibly not appreciated by some of those who feel instinctively that a lower speed of revolution must involve lower stresses. Instinct here is at fault. In case the reasoning is not at once apparent, I need only add that in the smaller engine of the same piston speed, the higher accelerations give no higher loadings because the masses diminish as the third power, while areas vary only as the second power of the linear dimensions.

Turning now to a mere matter of opinion, I am inclined to recommend a piston speed of not more than 1500ft. per minute for the oil engine of a locomotive. In these days this is a conservative value to take, but in an engine of 6½in. or 6in. stroke, it gives a rotational speed as high as 1400 or 1500 r.p.m. Such an engine, while as inexpensive in first cost per horse-power, would have lighter bearing loads than the 8in. stroke engine advocated in the recent paper by Lieut.-Colonel Fell.

OLIVER THORNYCROFT.

Old Shoreham, January 31st.

THE DICTATORSHIP OF SCIENCE.

SIR,—In your recent editorial on "The Dictatorship of Science," you show clearly that control of the destinies of the country by scientists would be both impossible and undesirable. There is, however, a sphere in which the scientific mind might be usefully employed, and which is, at present, entirely neglected, or is left to the partisan and the demagogue.

Science has led the way to our material development, but full advantage cannot as yet be taken of its achievements, because our economic progress has lagged behind. I submit that it is time that engineers, as representatives of the practical scientific mind, should investigate the whole subject of economics with a view to raising it out of its present state of neglect. An impartial study, made by a committee appointed by the chief engineering societies, would be able in a short time to produce definite results. These could then be placed before the public for the country as a whole to make its choice between a continuance of the present method of *laisser faire*, or the adoption of a system of ordered progress.

I submit, Sir, that your paper, as representing both engineers and manufacturers, should use its influence with this object in view, so that we may help ourselves towards recovery, instead of incurring the reproach of sitting down while our machinery stands idle, our dividends are unpaid, and our labour is unemployed.

W. R. MCLAUGHLIN, A.M. Inst. C.E.

Grays, Essex, January 31st.

THE LARGEST COFFERDAM.

SIR,—The cofferdam referred to on page 93, column 3, and on page 101 of your issue of January 27th, is not the largest. It encloses an area of 43 acres, whereas a cofferdam enclosing 46 acres was constructed for the season's work on the Sukkur Barrage piers and floor in 1929, the 1929–30 cofferdam in the series referred to on page 106 of your issue of January 22nd, 1932.

It was, in other respects, also, a major work of its type, the volume of material removed by dredgers and excavation being about 550,000 cubic yards, and the volume of masonry and concrete in the piers and floors, together with stone pitching placed within it, amounted to more than 94,000 cubic yards. R. A. RYVES.

Westminster, January 27th.

THE area of the Indian Empire, according to the latest estimate, is given as 1,808,679 square miles. This gives on the Census figures of total population a mean density of 195 per square mile, the maximum being found in Cochin State, with a population of 814 to the square mile. In British India the most thickly populated area is Bengal, where there is a population of 646 to the square mile. The most sparsely populated areas in the Empire are Baluchistan with 5, and British Baluchistan with 9 to the square mile. The total population of India, as actually given, is 352,837,778, of whom 271,526,933 are inhabitants of British India.

Railway and Road Matters.

THE railway companies have requested the Prime Minister to receive a deputation from them on the general position of the railways. This, it is said, is prompted by the desire that, in anticipation of a consideration of the Salter report, the Cabinet should be in possession of the fullest possible information.

MANY railwaymen and locomotive enthusiasts will remember Mr. J. J. Richardson, who was the locomotive running superintendent of the London, Brighton and South Coast Railway, and will regret to hear of his death on January 18th, at the age of seventy-seven years. Mr. Richardson held that position for fourteen years, and retired in 1915.

THERE have, during the last seven days, been two collisions between passenger trains and goods trains. The first was early on Saturday morning, near Three Bridges on the Southern Railway, and the second was on Tuesday, at Loughborough on the former Great Central section of the London and North-Eastern. The goods guard in the former case was seriously injured, whilst the fireman of the passenger train at Loughborough was killed. The line at Three Bridges is electrically operated, and protected by automatic signals.

WHILST, as we recorded on December 16th, the Free State Government subsidised the railways in their territory so as to avoid the necessity of putting into effect the Irish Railway Wages Board's award for a 10 per cent. reduction in the men's pay, no such concession was made by the Government of Northern Ireland, and the railways there resolved to adhere to the award. As a consequence, a strike commenced on the latter lines at midnight on Monday, January 30th. The Great Northern Railway runs in both territories, and the railway unions have solved that anomaly by also calling out the men in the Free State, even though they continue to draw their former pay in full.

THE Great Western Company's district traffic manager at Manchester said recently, in support of his statement that trade, as far as Lancashire was concerned, had turned he corner, that at the Liverpool-road goods station the Great Western had dealt with 71,414 more consignments than in 1931, and in spite of reduced rates the revenue had been virtually maintained. On the parcels side the revenue had again been maintained, and they had dealt with 36,000 more parcels than in the previous year. A feature of the year's working was that the export trade through Southampton showed an increase of 30 per cent. in tonnage, and the demand for the company's special services, such as containers and registered transits, showed increases of 9 and 46 per cent. respectively.

IN this column on January 20th, we quoted from the *London and North-Eastern Railway Magazine* a note by Mr. John Miller as to the use of shortened fish-plates. In the same issue was also a note by Mr. W. A. Fraser, the chief engineer for the Scottish area, as to a petrol-driven generator providing current for four electric flood-lights for work on the track at night and driving a sleeper boring machine and a coach screw-driving machine. The generator has a 9 H.P. engine and an electrical output of 6 kW, which provides something like 12,000 candle-power. The generator is only 2ft. wide overall, and so occupies only a small space, having, in that respect, an advantage over an air compressor which, moreover, cannot provide any light. The boring machine can bore 400 holes per hour, and the screwing machine can drive 500 screws per hour.

IN the L.M. and S. station, Leicester, on Monday, January 23rd, a passenger train from Nottingham ran into one which was about to leave for Birmingham. Presumably the accident will be inquired into by the Ministry of Transport, and, if so, it will be interesting to see whether or not a calling-on arm is used at Leicester for admitting a train into the station when another is already at the platform. Calling-on arms were first introduced on the London and North-Western Railway as a substitute for the signalman pulling up the second train at the signal-box by the exhibition of a red flag, and thus verbally cautioning the driver. It is a rule that tau train must be stopped at the home signal and the calling-on arm, which is lower down on the same post, is lowered, and the driver then proceeds cautiously, prepared to stop at any point. Our reason for mentioning these facts is that for the first time the accidents in which calling-on arms figured were the subject of a special paragraph in Colonel Mount's report on the accidents of 1931. It was then stated that twelve accidents, as compared with thirteen and twenty-four for the years 1930 and 1929 respectively, were reported in which the use of a calling-on signal was involved.

THE general manager of the South African Railways has again been good enough to send us a copy of his annual report. It is for the year ended March 31st, 1932, and is encouraging because of the optimism expressed in the opening pages. Mr. Moore observes that the financial difficulties experienced by his department as a result of the depression were very much more disturbing during the year under review than during 1930–31. Nevertheless, compared with the seriousness of the figures disclosed in the results of railway operations in most other countries in the world, the financial position of the railways in South Africa is by no means discouraging. After giving some figures as to the results of the year's working, the report says that the returns for the first four months of the present financial year show that further substantial reductions will be realised during the current year. The figures for the four months—April to July, 1932—show that the working costs were, compared with the corresponding period of 1931, reduced by approximately 16 per cent. That, Mr. Moore remarks, is reassuring, and, in conjunction with the fact that for some considerable time past railway revenue has shown distinct signs of stabilisation, justifies the belief that the turn of the tide is not far distant, and that next year—1933—will bring the gradual restoration of prosperity to South Africa. Without attempting to prophesy, he is convinced that the current year will see the low level of the depression, and that improvements will thereafter steadily take place. There is evidence of greater confidence, and the greater the confidence the sooner better times will arrive.

Notes and Memoranda.

A THIN veneering brick has been offered to the market by an important United States manufacturer of roofing tile. Only 1¼in. thick, supported by metal strips nailed to the frame of the dwelling, it weighs 80 per cent. less than ordinary brick, requires no foundation, and can be used to veneer either old or new houses.

IN Lake Zürich, at Wädenswill, in Switzerland, there is a harbour breakwater which does not extend down to the foundations. The breakwater proper is a reinforced concrete structure only 14ft. deep, of which some 8ft. is below water. This breakwater is supported on piles, some of which are as much as 85ft. long, but it prevents waves from gaining access to the harbour.

AN ingenious machine has been evolved in America for wrapping steel pipe with cement for protection against corrosion. The pipe is put in a form of lathe and is coated with cement reinforced with wire netting and wrapped with cotton cloth. For the purpose of the Hatch Hetchy water supply to San Francisco, some 2400ft. of 66in. pipe is being covered with ½in. of cement daily by one plant.

WOODEN shingles as a roof covering have, says the *Contract Record* of Canada, been in use for centuries, and still predominate in the house-building field. While well-cut shingles of straight-grained lumber have a life of ten years upwards, even when unstained, their usefulness is greatly enhanced by creosoting and staining under pressure. This treatment renders the shingles more fire-resistant, increases their longevity, and adds to their appearance.

THE tower for supporting the antenna of the radio station at Nashville, Tennessee, is 878ft. high. It is square in section and tapers outwards from 2½ft. square at the base to 38ft. square at the level where the guys are attached. Above it tapers down again to 3ft. square at a height of 758ft., where it is surmounted by a tubular pole, 120ft. high. The tower was designed to withstand a wind pressure of 30 lb. per square foot, and weighs about 150 tons.

IN New York harbour there are, says the *Engineering News-Record*, two high and two low waters each day, while in Pensacola Bay there is only one high and one low water each day. At Galveston there are two high and two low waters each day for part of the month and only one high and one low water during other times. At Seattle the two high waters of the day are much alike, while the two low waters may differ by as much as 8ft. or more. At Honolulu, on the other hand, the two low waters of each day are alike, while the two high waters differ; and at San Diego both the high waters and the low waters of each day show marked differences.

A 520 kW, 20,000-volt metal-clad mercury-arc rectifier has recently been tested for over a year in the research laboratories of the German State postal authorities for supplying power to broadcasting stations. According to Nikolay von Kotschubey, of Zurich, nine broadcasting stations in Germany are supplied with similar rectifiers and installations are planned, or are being made, in the Irish Free State, Switzerland, Poland and Hungary. Of special interest is the stability of these rectifiers on short circuit. By grid control it is reported possible to suppress output almost instantaneously when the delivered current rises above the allowable value.

AN article in *The Electrical Review* describes the method adopted for measuring the resistance of an earthing system for a group of two three-phase, 1500 kVA transformers installed at a cement works. The subsoil consisted of hard chalk, which has a high resistivity. In view of the unreliability of ordinary earth plates, and the cost of excavation, a multiple earthing system was employed, consisting of a number of galvanised wrought iron pipes, 8ft. long, driven into the ground at intervals of 6ft. and connected together by means of bare copper strip. This method has the advantage that should the desired resistance figure not be obtained, the installation can be extended at very little extra cost.

RADIO-ACOUSTIC ranging consists of measuring with high accuracy the time of travel of a sound wave along the line whose length is to be determined. At one end of the line a small bomb of T.N.T. is exploded under water; a hydrophone is placed at the other end. The vessel firing the bomb is equipped with an apparatus for recording both the time of firing and the time of receipt of a radio signal. The vessel or shore station to which the hydrophone is connected has apparatus for converting the incoming sound into a radio signal, which is instantly transmitted to the first vessel. By measuring the time of travel of the sound the distance between the bomb and the hydrophone can be computed from the known velocity of sound through the sea water. By this method the distances between the buoys are determined.

ALTHOUGH mechanical science has greatly improved the structure and design of cultivating implements, until quite recently all the major cultivations, whether by horse or tractor, were on the age-old principles of the turning action of the plough or the shattering effect of the hoe. A new system is, says *Nature*, now being introduced and scientifically examined. Rotary tillage, the milling of the soil by revolving tines, instead of the bodily movement or disturbance by the drawn implement, is the most natural way in which the internal combustion engine can be directed to the comminution of the soil. Rotary cultivation is gaining ground in small occupations, where it is employed as a substitute for the joint action of spade and rake; but larger machines are being developed for full-scale cultivation, where they will do in one operation the work of tractor plough and the cultivators and harrows which follow them. The aim of all cultivation should be, so far as possible, to let the weather do the work. Alternate wetting and drying, frost and thaw, have a wonderful mellowing effect on soil, and this greatly assists the formation of a seed bed, whether by the older or newer implements. To force a tilth against the weather is an expensive operation and at best only a makeshift; but in case of need the rotary cultivator presents more opportunities in this direction than the traditional implement.

Miscellanea.

A LARGE textile factory is to be put up in Bradford by a French firm.

THE first arrival at the Monte Carlo car rally this year was a Gardner oil-engined Bentley.

DURING 1932 Spain produced 288,000 tons of pig iron, 1,847,000 tons of iron ore, and 6,800,000 tons of coal.

AFTER nearly 2½ years of constructional activities, the new 4,000,000 dollar waterworks system at Calgary, Alberta, has been brought to completion.

A NEW bridge estimated to cost 5,000,000 dollars is proposed across the St. Lawrence River from near Ivy Lea, Leeds County, Ontario, to Hill Island.

A FACTORY capable of producing 100,000 tons of sulphur a year is to be put up at Darien by the South Manchuria Railway Company, at a cost of about £2,000,000.

THERE were 745,000,000 telephone calls made in the London area during 1932. The number of exchanges has increased from 154 in 1931 to 232, of which 60 are automatic.

SAFETY first warnings are now issued to miners at the Wyndham Colliery by means of loud speakers working in conjunction with a gramophone record dictated by the manager.

A SCHEME for the control of the river Dee flooding is being considered. It comprises the substitution for the present weir at Chester of a series of three control gates, each 120ft. long.

THE Pedestrians' Association recently gave a demonstration of a "tell-tale" light for motor passenger vehicles, which indicates to the driver when he is exceeding the statutory speed limit.

THE Empire Marketing Board's exhibit at the B.I.F. Olympia section will cover some 13,000 square feet. The number of Dominions and Colonies taking part has increased to nineteen.

A SCHEME is in hand for the construction of a motor racing track at Ivinghoe, with a course 4 miles long, and a straight run of 1 mile. It is thought that speeds of 130 miles per hour will be attainable.

AT the annual dinner of the Dover Chamber of Commerce, Mr. G. Salmper said that the Channel train ferry to be built at Dover would cost about three-quarters of a million pounds sterling and that tenders for the ships for the service were soon to be called for.

IN a statement to the *Cape Times*, Sir Eric Geddes, chairman of Imperial Airways, who is now in Cape Town, foreshadowed regular Transatlantic air services from Northern Ireland in conjunction with American and Canadian interests in a very few years.

AN electric train service between New York and Philadelphia was inaugurated by the Pennsylvania Railroad on January 16th in the running of four round trips of regular trains. The service will be expanded until the entire schedule is electrically operated, thus completing another stage of the railway's electrification scheme for its main line between New York and Washington.

THE Tokyo Ministry of Communications has approved the application of Baron Yoshiro Fujimura and others for permission to establish a concern to be known as the International Wireless Telephone Company, Ltd. The concern will have a capital of yen 13,250,000. Within two years it is to perfect equipment for direct telephone services with Europe, America, Java, Hong Kong, Changhai, Formosa, and Darien.

PARTICULARS of the new dock for landing petrol, now nearing completion at Ellesmere Port, were recently given by Mr. H. A. Reed. It will have a caisson or boom 16ft. wide by 7ft. deep, made of pitch pine and brushbox, for closing the entrance. It is expected that if the boom were attacked by fire it would be charred on the outside, but would prevent the escape of burning petrol to the canal while a fire in the dock was burning out.

THE *Chinese Economic Bulletin* states that in order to bring northern and southern Kiangsu into closer contact, the Provincial Reconstruction Department is planning an extension of the present long-distance telephonic system in southern Kiangsu to six important cities in the northern part of the province. According to present plans, the nine cities of Soochow, Wukiang, Changshu, Wusih, Kiangyin, Liyang, Changehow, Ihing, and Tanyang in southern Kiangsu, will be linked up with Nantung, Yangchow, Taihsien, Tsingkiangpu, and other important cities of northern Kiangsu.

THE immediate development of the iron ore deposits of the Bessemer range, near Loon Lake, Thunder Bay district, Ontario, is being undertaken. Present plans call for the mining of 10,000 tons of ore this winter. The area to be worked comprises 4000 acres; 4,000,000 tons of ore, it is stated, already have been blocked out in the area where operations will be carried out this winter. Samples of ore from the property under lease, which is about 25 miles east of Port Arthur on the main line of the Canadian Pacific Railway, are stated to run from 53 to 65·4 per cent. iron, with little phosphorus and low sulphur content.

THE International Aluminium Competition has resulted in the following awards:—4000f. to Dr. Eckert, Grevenbroich, Germany, for researches on the protection of aluminium and its alloys by the M.B.V. process and the improvements made in this process; 4000f. to Mr. Philippe, Paris, France, for a memorandum on the use of aluminium alloys in gas or oil-fired central heating plant; 3000f. to Mr. Y. Hirakawa, Yawata, Japan, for an article on aluminium tuyères for blast-furnaces; 3000f. to Mr. Th. Schweizer, Zürich, Switzerland, for a memorandum on the use of aluminium for grain silos; 2000f. to Mr. Py, Paris, France, for an improved model of an aluminium alloy bicycle; 2000f. to Mr. Steinborn, Rodange, Luxemburg, for a study of the possibilities of the use of aluminium and its alloys in blast-furnaces and steel works; 2000f. to Mr. H. Tatu, Lyons, France, for a memorandum on the use of aluminium in dyeing and cleaning.

(For description see page 110.)

Fig. 3—The equipment employed for dredging the trench in the mud and silt portion of the East River Bed.

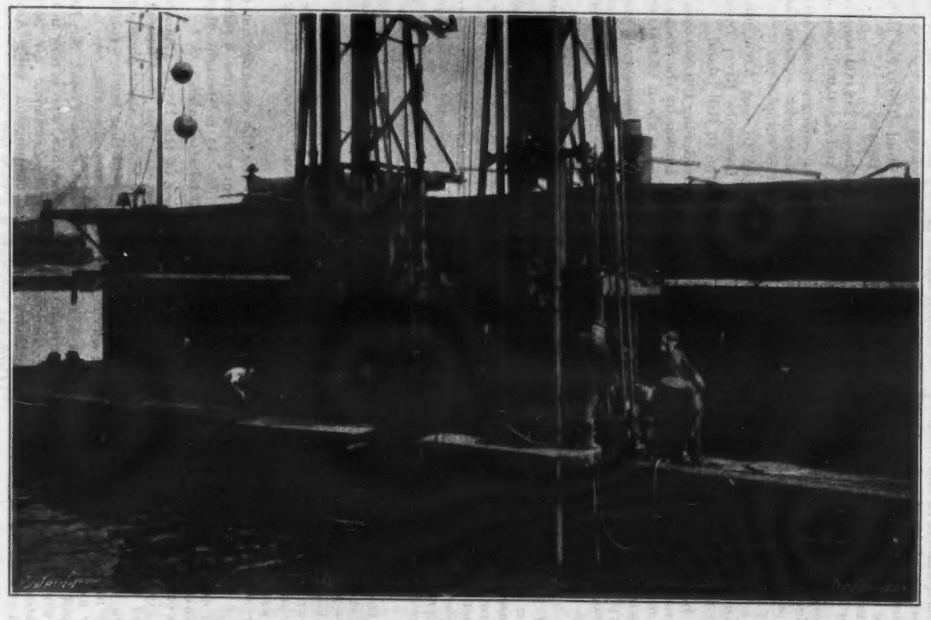


Fig. 4—The steam-operated rock drills used on the rocky portion of the river bed.

Fig. 5—Laying a pair of the fourteen cables in the trench showing the long guide rollers to accommodate sideways shift of the barge.

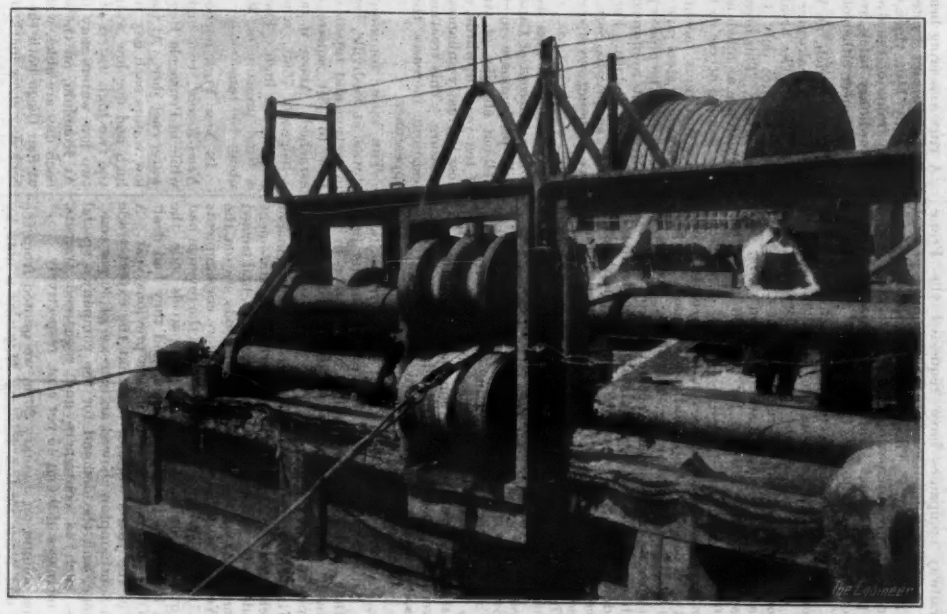


Fig. 6—The submersible guide hung from the derrick of the cable-laying barge controlling the drop of the cables into the trench.

The Engineer

FEBRUARY 3, 1933.

VOL. CLV. No. 4021

Contents.

THE ENGINEER, February 3rd, 1933. PAGE

A SEVEN-DAY JOURNAL . . . 107
HEAT TRANSFERENCE IN SUPERHEATERS . . . 108
THE INTERNATIONAL RAILWAY CONGRESS. No. III. . . . 109
BROOKLYN–NEW YORK POWER CABLES. (Illus.) . . . 110
HANDLING AND STORING OF GRAIN. (Illus.) . . . 111
BRYCE FUEL INJECTION EQUIPMENT. (Illus.) . . . 115
LETTERS TO THE EDITOR—
Oil-Electric Locomotives—The Dictatorship of Science—The Largest Cofferdam . . . 116
RAILWAY AND ROAD MATTERS . . . 117
NOTES AND MEMORANDA . . . 117
MISCELLANEA . . . 117
LEADING ARTICLES—
The Return of the Capital Ship . . . 119
Compound Locomotives . . . 119
THE HANDLING AND STORING OF GRAIN: INSTITUTION OF MECHANICAL ENGINEERS . . . 120
AGRICULTURAL ENGINEERING ABROAD . . . 121
SIXTY YEARS AGO . . . 121
SHORT NOTICES . . . 121
RING MAIN FEEDER PROTECTION: NON-PILOT SYSTEMS. (Illus.) . . . 122
COAL AND OIL . . . 123
AMERICAN ENGINEERING NEWS . . . 123
HARDENING AN 8FT. DIAMETER GEAR WHEEL. (Illus.) . . . 124
THE "WEE-MAC" PUMP. (Illus.) . . . 124
IMPROVED CIRCULATING PUMP FOR HOT WATER HEATING SYSTEMS. (Illus.) . . . 124
SIX-WHEELED STEEL BRAKE VANS, L.M.S.R. (Illus.) . . . 125
EARTH RESISTANCE TESTS ON TRANSMISSION LINE TOWERS. (Illus.) . . . 125
ELECTRO-DEPOSITION . . . 125
THE MASSEY ACCELERATOR. (Illus.) . . . 125
PNEUMATIC DISPATCH SYSTEM IN A STEEL WORKS. (Illus.) . . . 126
PROVINCIAL LETTERS—
The Midlands and Staffordshire . . . 127
Lancashire . . . 127
Sheffield . . . 127
North of England . . . 128
Scotland . . . 128
Wales and Adjoining Counties . . . 129
BRITISH STANDARDS INSTITUTION . . . 129
PERSONAL AND BUSINESS ANNOUNCEMENTS . . . 129
CONTRACTS . . . 129
CURRENT PRICES FOR METALS AND FUELS . . . 130
FRENCH ENGINEERING NOTES . . . 131
BRITISH PATENT SPECIFICATIONS. (Illus.) . . . 131
FORTHCOMING ENGAGEMENTS . . . 132

NOTICES TO READERS.

*** *If any Subscriber abroad should receive* THE ENGINEER *in an imperfect or mutilated condition, he will oblige by giving prompt information of the fact to the Publisher, with the name of the Agent through whom the paper is obtained. Such inconvenience, if suffered, can be remedied by obtaining the paper direct from this office.*

*** *For Subscription rates, see page 2 of Advertisements.*

*** *All letters intended for insertion in* THE ENGINEER *or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

*** *No undertaking can be given to return drawings or manuscripts; correspondents are therefore requested to keep copies.*

DEATH.

ON Monday, January 30th, in London, GEORGE JAMES SHAVE, M.I. Mech. E., chief engineer of the London General Omnibus Company.

THE RETURN OF THE CAPITAL SHIP.

TEN years ago the battleship's "expectation of life" was such as would have justified a very high premium against the risk of extinction. Distinguished naval officers at home and abroad condemned the great ship as an anachronism and prophesied its speedy disappearance. The five leading Powers had agreed to suspend this class of construction for ten years, and the belief was widespread that the capital ship had ceased to fill any useful *rôle* in modern naval tactics. To their credit be it said, the majority of British naval officers never subscribed to these radical views. Mature reflection on the lessons of the Great War had convinced them that the big ship, armed with heavy guns, was still the dominating factor, "the backbone of our naval power," as an Admiralty memorandum expressed it in 1921. Subsequent events appear to have vindicated their judgment; at any rate, several capital ships are now under construction, and there is every prospect of more being laid down in the near future. Germany took the initiative by starting, in the autumn of 1928, that much-discussed ship, the "Deutschland." Although a pigmy compared with such monsters as the "Hood" or the two "Nelsons," she carries an armament that places her definitely in the capital class, and it is not denied that she could engage in a long-range duel with almost any battleship or battle cruiser now afloat with a reasonable chance of survival. This, we believe, to be a fair estimate of a ship that has a broadside of six 11in. guns, protection equal to that of a pre-war armoured cruiser, and a speed that would enable her to choose her own range in action with any battleship. It is certain that her fighting powers are immensely superior to those of the 10,000-ton cruiser type, mounting 8in. guns, which the Washington Treaty foisted on the naval world, and fifty-five units of which have been built to date in Europe, the United States, and Japan. None of these hybrid craft could stand up to the German "pocket battleship," though she is no larger than they. As we write, the "Deutschland" is running her preliminary trials at sea, and all who appreciate boldness and ingenuity in the realm of technical development will share our hope that this remarkable warship will fulfill every anticipation of her designers. A sister vessel, "Ersatz Lothringen," is to be launched on April 1st, and a third unit, "Ersatz Braunschweig," was laid down in October last. It is proposed to begin a fourth next year.

As might have been predicted, the building of these small but powerful capital ships has produced repercussions in the naval world. They have depreciated the value of the 10,000-ton cruiser to such an extent that the construction of the type has virtually ceased, the United States being the only country in which it still finds favour. France has deemed it expedient to build a battle cruiser as a retort to the German vessels. This ship, the "Dunkerque," which was begun at Brest in December, is the first full-scale capital ship to be laid down anywhere for ten years. From plans and details published in the French Press she is seen to bear a family resemblance to the "Nelson" class. She will displace 26,500 tons, the contract speed is 29 knots, and the armament is to comprise eight 13in. and twelve 6·1in. guns. Both main and secondary armaments are to be grouped in quadruple turrets. The 13in. gun positions are on the centreline in the fore part of the ship, the second turret being well in rear of, and at a higher elevation than, the first, this arrangement permitting the discharge of all eight guns directly ahead. In each turret the four guns are mounted in pairs, separated by a stout bulkhead. Each pair of guns is worked independently. On the other hand, all four weapons must, of course, be trained on a common point of bearing and will, therefore, be equally affected by errors in deflection. It is also evident that the system of shell and powder hoists must be very complicated in view of the abnormal space between the wing guns and the necessity of keeping the magazines well away from the sides of the ship. The 6·1in. guns are in quadruple turrets disposed pyramidwise in the after part of the ship, one turret on either beam and the third on the quarterdeck. There is also a number of anti-aircraft pieces and torpedo tubes, the details of which are uncertain. No definite particulars of the ship's protection are available, but it is reported unofficially that a waterline belt of not less than 9in. thickness will be associated with two strong decks and elaborate subdivision. The concentration of the main and secondary artillery in multiple turrets tends to reduce weight and centralise protection, but never before has it been carried to such a length. In the "Dunkerque" a single well-placed shell might put half the heavy guns out of action, and remembering the phenomenal number of turret hits registered at Jutland, we should not care to see the armament of a British ship disposed on the same principle. The next Power to resume capital ship construction may be Italy, whence it is reported that tentative designs have been prepared and tank experiments conducted with a view to the building of such a vessel. Unless, therefore, a new naval "holiday" is agreed to by all the major Powers without delay—an improbable contingency, since it would involve the scrapping of the "Dunkerque" and several, if not all, of the "Deutschlands"—battleships are certain to reappear in the building programmes of this country, the United States, and Japan, when existing treaties expire in 1936. This circumstance lends interest to such forecasts of our future capital ships as have been made. In the official British plan of disarmament tabled at Geneva last year a restriction of capital ships to 25,000 tons and 12in. guns was proposed, with an alternative limit of 22,000 tons and 11in. guns provided that cruiser tonnage and armament were drastically reduced. Taking the higher figures as a basis, Sir George Thurston has outlined in the new edition of "Brassey's Naval and Shipping Annual" a project for a battleship adapted to British requirements. This is a vessel 560ft. in length, with a beam of 92ft., and a draught of 29½ft. at 25,000 tons standard displacement. She would be equipped with geared turbines and small-tube boilers, the plant developing 30,000 H.P. for a speed of 22 knots. A 12in. waterline belt, tapering at the extremities, 14in. barbettes, and 7in. armour on the citadel containing the secondary armament, are features of the protective system. There would be two armoured decks in way of machinery, magazines, and barbettes, of a combined thickness of not less than 6in. "The underwater protection against submarines and mines to consist of a slight swelling out, or 'bulge,' incorporated in the vessel's structure, with at least two longitudinal bulkheads, one armoured; one placed about midway between the shell and the inner bulkhead, which latter should be kept as far from the side as machinery and magazine arrangements will allow." The armament proposed is twelve 12in. guns in triple turrets, grouped in pairs forward and aft; twelve 6in. guns in a broadside battery; eight 4in. or 4·7in. A.A. guns, and two 21in. or 24in. torpedo tubes. A complement of seaplanes with launching gear, and possibly an outfit of mines and depth-charges, is suggested.

With many of the features of this design we find ourselves in agreement. We should, however, prefer a shorter and broader ship, the substitution of eight 13·5in. guns on twin mountings, for the twelve 12in. in triple turrets, and the deletion of all torpedo tubes, mines and depth-charges. It is true the 12in. gun was recommended in the British programme at Geneva, but with the tacit proviso that no greater calibre be adopted in any navy. On the other hand, neither the United States nor Japan has shown any disposition to accept this limit, and France has definitely repudiated it by arming her new battle cruiser with 13in. guns. We are, therefore, of opinion that a restriction to 12in. is impracticable. The 13·5in. firing a 1400 lb. projectile, is a weapon of proved value, accurate, hard-hitting, and easy to manipulate. Moreover, a ship armed with this gun need not shirk action with an opponent carrying 15in. or even 16in. metal. And, finally, we know that the vast majority of British gunnery officers look askance at triple mountings, and much prefer the well-tried system of twin turrets. Except by torpedo specialists the fitting of torpedo tubes in capital ships is regarded as a useless encroachment on space and weight, while the carriage of mines or depth-charges by such vessels would seem equally futile. As for the relation of beam to length, it may be that a long and narrow ship is better able to keep her speed in a seaway, but for a 25,000-ton ship designed for 22 knots this principle is unimportant. Much more to the point is the fact that ample beam gives better protection against underwater attack. The thickness and distribution of armour suggested by Sir George Thurston appears to be satisfactory, and with the modifications we have indicated we are inclined to accept his forecast of the future capital ship of the British Navy as sound. It will not be forgotten that his prediction of our post-Washington battleships and cruisers proved accurate in all essential features.

Compound Locomotives.

THE appearance of Mr. Glover's new compound express passenger engines on the Irish Great Northern Railway again directs attention to a question in locomotive design which in the past has caused more discussion than perhaps any other throughout more than a century of development. Though the subject is, therefore, old and some may think threadbare, we, nevertheless, are not disposed to offer any apologies for making reference to it at the present time. In earlier days compounding received the attention of many eminent engineers, and on our own railways the names of Webb and Worsdell will be recalled, whilst abroad de Glehn, Von Borries, Golsdorf, Vauclain, and others readily come to mind. It is not our intention to discuss the work of these pioneers of locomotive compounding, but rather to draw attention to certain considerations which are reviving interest in compound locomotives even in this country. Many changes have been made since compounding was first tried and in certain instances found wanting, and it may well be worth while just to draw attention to certain new factors operating in favour of the compound.

Take, first of all, the question of steam pressures. Even if we assume a normal locomotive boiler, it is now quite possible, thanks to improved materials and manufacture, to employ relatively high working pressures if required, and whereas formerly engines having only two cylinders were the rule, now we have accepted the three and four-cylinder locomotive as a matter of course for modern high-speed requirements. With the improvement of materials, enabling reduction in weight to be effected, the objections urged against added complication and the multiplicity of parts no longer hold. Take again superheating. It is quite true that its introduction was thought to make compounding unnecessary, but in the light of results now being obtained with superheating and compounding combined, there is reason to

think that if superheating alone improved the simple engine, it certainly has also helped the compound. One other consideration is also of moment, and that is the design and proportions of cylinder ports and steam passages. This subject has not been given enough attention, for the reason that any increase in the dimensions of steam and exhaust ports at once increases the size and weight of slide valves and also piston valves, thus, in the case of large engines, throwing high stresses on the valve motion and causing heavy upkeep costs. The value of large ports is very considerable, more especially, of course, for the low-pressure cylinders, which, owing to the low pressure, have to deal with a large volume of steam. If we are to be in any measure guided by experience on the Continent, especially in France, it would appear that valves of the poppet type might receive consideration, for it is worthy of note that the latest compounds on the P.L.M. are so equipped and the Paris–Orleans rebuilt "Pacifics" have also been fitted with valves of this type. The importance of cylinder design and the influence it has upon efficiency was very well brought out by Mr. E. L. Diamond in his exhaustive analysis of the subject contributed to the "Proceedings" of the Institution of Mechanical Engineers in 1927. According to this investigation, the efficiency of the steam action in the cylinders of the Midland compounds is about 60 per cent., whereas carefully conducted tests made on the Paris–Orleans with a four-cylinder compound engine, with poppet valves and of the "Pacific" type, show a cylinder efficiency of as much as 80 per cent., based on the Rankine cycle, assuming exhaust at atmospheric pressure. In many respects the performance of this locomotive is notable, for, though of moderate size, it has maintained remarkably high rates of power output. For instance, at 74 miles per hour, a maximum of 3030 cylinder horse-power has been developed, equal to 1 indicated horse-power for each 72 lb. of engine weight, whilst at this rate of working only 0·91 square foot of total heating surface, including the superheater, was required per horse-power. Numerous runs showed that the cylinder feed per horse-power hour was not more than 13·8 lb., and minimum consumptions recorded were as little as 12·1 lb., with a low record of 11·2 lb., the latter figure giving a coal consumption per draw-bar horse-power hour of 2·69 lb., the evaporation per pound of coal, as fired, being 7 lb. An interesting feature of this locomotive is the moderate boiler pressure employed, which is 227 lb. per square inch, a figure well within the range of the ordinary locomotive type boiler. These very satisfactory results of a French compound are attributable largely to the high steam temperatures maintained, which reach 740 deg. Fah. in the high-pressure steam chests, at which temperature considerable superheat is present in the low-pressure cylinders. The working results shown by this locomotive are so good that a number of others of the same class have been rebuilt in a similar manner.

It must be admitted that these engines, the tests of which were authoritatively reported upon in the *Revue Générale des Chemins de Fer*, July, 1929, evidently point to the economies possible when compounding is intelligently applied to modern locomotives for fast passenger service. In comparison with other means of motive power for railway traction, the steam locomotive has certain well-defined inherent advantages, but it cannot retain its place if development is allowed to cease. In France the compound locomotive has always done better and been more favourably received than in this country. Its unsuitableness for British conditions was apparently settled many years ago; but it has always retained some measure of confidence even here, and it would be short-sighted to close our eyes to the fact that the new conditions to which we have referred may have altered the case.

BOOKS RECEIVED.

Electrical Contracting Organisation and Routine. By H. R. Taunton. London: Sir Isaac Pitman and Sons, Ltd., Parker-street, Kingsway, W.C.2. Price 12s. 6d. net.

The Colliery Manager's Pocket Book and Diary, 1933. Edited by H. Greenwell, F.S.S., &c. London: Colliery Guardian Company, Ltd., 30 and 31, Furnival-street, E.C.4. Price 3s. net.

Brassey's Naval and Shipping Annual, 1933. Edited by Commander C. N. Robinson, R.N., and H. M. Ross. London: Wm. Clowes and Sons, Ltd., 94, Jermyn-street, S.W.1. Price 25s. net.

Molesworth's Metric Tables. Seventh edition. By Sir G. L. Molesworth, revised by W. H. Molesworth, M.I. Mech. E., &c. London: E. and F. N. Spon, Ltd., 57, Haymarket, S.W.1. Price 2s. 6d. net.

The Handling and Storing of Grain.

INSTITUTION OF MECHANICAL ENGINEERS.

IT is commonly asserted that any paper on locomotives or in any way connected with railways is sure to attract a good audience, and produce a good discussion at the Institution of Mechanical Engineers. It is possible therefore that the large and appreciative audience which assembled at the meeting of the Institution in London on Friday evening, January 27th, to hear Mr. H. H. Broughton's paper, "The Handling and Storage of Grain, with Special Reference to Canadian Methods," was attracted by the fundamental appeal of a railway subject. It is certainly true that in a considerable measure the successful transportation of wheat from the Prairie Provinces to the mills of the United Kingdom is dependent upon railway operation and co-operation. Without the aid of the railways to move the grain from the collecting points in the farming belt to the head of the Great Lakes, and, later in the season when the Lakes and the St. Lawrence are frozen, to carry it to the Atlantic seaboard, the great river of wheat which flows to us from the Dominion would quickly become dammed up.

The railways are, however, only one factor in the movement of the grain. The ships which carry it down the Lakes and through the canals to Montreal, and those which transport it across the ocean are at least as essential to the movement as the railways. No less essential are the small and large silos—or "elevators," to give them their New World designation—in which the grain on its journey from the farms to the mills is collected, sampled, graded, dried, and cleaned, in which it is stored as required, and from which it is despatched on the next stage of its journey. The silos are, in fact, the fly-wheels which keep the whole system of transportation in uniform motion. Without them the railways and shipping would be disorganised by congestion alternating with periods of idleness. In addition, without the silos the Government's Board of Grain Commissioners would be deprived of much of that opportunity, which it now exercises to the full, to supervise the quality of the grain, and in general to hold the balance of justice and fair dealing between the farmers and the millers.

Mr. Broughton's paper had, it will be gathered, a multiple interest. Agriculture, railway operation, shipping, and the design and construction of silos all entered into it. Overriding any sectional appeal, however, it attracted the members of the Institution by its human interest. It made many of them realise, perhaps for the first time, the circumstances in which their daily bread is brought to them. It revealed to them the supreme degree to which the arts of the mechanical engineer enter into these circumstances and make possible the supply of that bread on the scale now demanded. It showed them a brief but startling picture of the chaos and famine which would result if the complicated machinery of the system of supply failed to operate for a few weeks.

The ground covered by the paper was perhaps too large and too diversified to engender a really good discussion. Yet any one of half a dozen of its features might have been made the subject of a whole evening's profitable debate. On the broad issue of whether we in this country are imperilling our safety by failing to provide adequate national storage for the wheat which we import from overseas—amounting to six-sevenths of the wheat which we consume—much more might have been said than was contained either in the paper or in the remarks of those who touched upon this subject in their contributions to the discussion. The Royal Commission on Supply of Food in Time of War considered this subject in 1904, and came to conclusions which the actual experiences of war did much to falsify. Mr. Bentham, discussing the point, admitted that the Great War had revealed the precipice at the edge of which we had been standing as regarded our supplies of grain. A little lightly, however—or so it seemed to us—he proceeded to argue that the question of national storage no longer existed, and that the real solution of the problem lay in the private or commercial storage of grain. We were glad to have his assurance that there already existed or that there was now being provided a large storage capacity in this country, and that there was little fear of a shortage if it were kept full. Nevertheless, it was to a certain extent disquieting to learn that the bulk of the storage capacity to which he was referring was not provided by the dock or other public authorities, but was owned by the private milling firms. Mr. Binns reminded us that of the 280,000,000 bushels of wheat which we in this country consumed annually, we grew for ourselves only 40,000,000 bushels. He told us, however, that of our overseas supplies, 60 per cent. came from the Empire and seemed to suggest that there was an element of safety in that fact. No port or private authority, he argued, could provide the storage capacity required to meet an emergency. In the handling of all forms of produce modern ideas were directed towards getting it to the consumer as quickly as possible, and eliminating storage to the fullest practicable extent. Something, we felt, must be wrong somewhere. The distribution of grain in this country is really only a continuation of the process which begins in Canada. If, then, the ideal to aim at is the reduction of storage capacity to zero in the United Kingdom, how does it come to be that, dictated presumably by practical requirements, Canada has equipped herself with storage capacity amounting to 139 per cent. of her annual production of grain? The meeting was, we think, favourably impressed by Mr. Broughton's rejoinder to those who looked with disapproval on the provision of adequate storage capacity in Great Britain. He reminded us of the 6,000,000 tons of shipping which we lost by enemy action in 1917, and asserted that safe storage of sufficient wheat to meet four to six months' normal consumption could be provided at an annual cost of 4½d. to 6d. per head of the population. What was that figure, he asked, in comparison with the cost in lives and ships which we had had to pay to avoid famine during the war years?

Turning to a more technical aspect of the paper, we could have wished to have heard an extended debate on the "moving form" system of constructing reinforced concrete buildings. That system, to be explained in the concluding portion of Mr. Broughton's paper which we shall reprint next week, and in a special article which he has written for us, is of quite exceptional interest to a wide circle of engineers. It was developed and has been chiefly used for constructing grain elevators or silos, but it is just as applicable to other forms of structure. It has, for example, been applied to the construction of a quay wall a mile in length. It consists, as the reader will find, of building a timber raft resting on prepared foundations, the raft constituting simultaneously a working platform for the concrete placers, and a mould, 4ft. deep, for the external and internal walls of the building. By means of screw jacks the raft is raised slowly upwards at the same rate as the concrete is poured into the mould, the weight of the raft and all upon it being taken upon vertical steel rods inserted beneath the jacks and passing downwards through the green concrete. In this manner buildings covering an acre or more of ground and 100ft. to 200ft. in height, are erected in less than a month entirely without scaffolding. The raft may cover the whole area of the building at the ground level, but at some height up it may be desired to stop off a porton of the structure while the remainder continues to rise. That portion of the raft corresponding to the part of the building to be stopped off is severed from the rest of the raft, which having been made good by the carpenters, continues its upward journey. The portion left behind serves as a deck or shuttering on which to cast the roof of the stopped-off part of the building. The rest of the raft may be further subdivided at higher levels, and at each level, including the topmost, the decking is used as shuttering for the roof.

Criticism of the moving form method was expressed by one or two speakers, but it was for the most part ineffective. One speaker thought that its advantages could be exaggerated, and that if the building in its upper stages were of a complicated character it would pay to use ordinary methods. The same speaker also argued that instead of making the raft cover the full area of the building it might be made to deal with only one-third of the area, and be used three times in succession. That method might entail a lengthened time for the completion of the building, but it would save on the high cost for the construction of the raft. Mr. Broughton assured him that this plan of subdividing the raft had been used twenty-five years ago. It has, so we learned later, been largely abandoned as unprofitable, partly because of the high cost of dismantling and re-erecting the forms and the delay which that work entails, and partly because the cost of the materials used in the construction of the moving forms represents only about one-fifth or one-quarter of their total cost.

Another speaker contended that if the system was to be profitable the moving forms would have to be used over and over again for successive buildings, and that consequently there was no chance of their being used in this country. Mr. Broughton, in reply, did not indicate the extent to which the materials employed in the fabrication of the forms could be salved and used again on another building, possibly of an entirely different design. The actual position, we understand, is that the timbering has no replacement value, but that the screw jacks may be used over and over again. Mr. Broughton contented himself with the statement that in general a building suitable for construction by means of moving forms could be constructed by that method for half to two-thirds the cost of a similar building constructed by means of fixed forms. He also referred his critic to an appendix in his paper—to be reproduced in our next issue—in which the cost of erecting a 400,000-bushel working house was detailed. The table showed that the cost of the forms per cubic yard of concrete amounted to 3s. 6d. for materials and 13s. 6d. for labour, while the cost of jacking them amounted

to 4s. 5d. for materials and 21s. 2½d. for labour. The materials and labour involved in the construction and movement of the forms therefore represented an expenditure of 42s. 7½d. per cubic yard of the concrete in the building. The total cost of the building amounted to 140s. 5½d. per cubic yard. It may be added that the figures given for the cost of the materials assume that none of them can be used again although, as stated above, the jacks, which are included among these materials, can be salved and re-used over and over again.

For the rest, the discussion brought up a few minor points, such as the use of high voltages in American elevators—a practice condemned by the author—the design of box cars with hopper bottoms to facilitate the discharge of grain from the railways into the silos, the cleaning of grain other than wheat, and the laws governing the flow of grain through an orifice. The President, Mr. Taylor, brought the discussion to a fitting conclusion, with a few well-chosen words, in which he emphasised the merit of the paper as a means of defeating the prevalent doctrine that the works of the mechanical engineer were for the most part a curse to civilisation. The handling and storage of grain by the methods described by Mr. Broughton have been specifically attacked by the so-called "technocrats" on the ground that the system is a powreful example of the displacement of human labour by machinery. Mr. Taylor contended that the paper had shown the inestimable benefit which the intervention of the mechanical engineer had conferred on humanity in the matter of ensuring to it an adequate supply of its most essential foodstuff.

Agricultural Engineering Abroad.

(By our Correspondent in Paris.)

THE annual show of agricultural implements and machinery in Paris last week, the holding in connection therewith of congresses that brought together manufacturers and agriculturists to discuss matters of technical and commercial interest, and the mass meeting of farmers whose attitude left no doubt that their grievances had reached a climax, crystallised the situation of agricultural engineers who found themselves viewing a somewhat complicated outlook. It is clear that the agricultural difficulties must be dealt with before there can be any definite improvement elsewhere. The phenomenally low prices of produce are a direct cause of the world crisis, and agricultural engineers are amongst the first to suffer from it. There is nothing wrong with the manufacturing industry itself. It is one of the most progressive of industries, because it works in a field where the opportunities for initiative are considerable. Notwithstanding the vast development of agricultural engineering abroad, it is probable that the amount of machinery now capable of being manufactured would fall short of the demand if all agricultural countries recovered their prosperity and if every farmer, who could use machinery, was educated to see that his interest lies in making the most of it. The conferences in Paris revealed the possibility of a considerable expansion of demand for machinery, as well as the necessity for an organisation which will bring manufacturers and farmers closer together, and, while enabling the engineer to see exactly what the farmer needs, will impress upon agriculturists the importance of machinery and its value as a means of ensuring regularity in farming operations and of reducing costs. Machinery is far from having penetrated into all centres of Continental agricultural production. There are still countries, and even parts of France, like Brittany, where grain is thrashed with the flail. Again, there is so great a diversity in agricultural conditions all over Europe that much has to be learned about the adaptation of machinery to requirements that are almost ignored by the engineer.

The idea that a great mass of foreign farmers are precluded from the use of machinery because they fail to appreciate it, or regard it as an expensive acquisition, or are unable to find just what they need, has suggested the formation of associations which aim at bringing engineers and agriculturists into closer contact. One of these is the Fédération Internationale des Techniciens Agronomes, which was constituted in Rome last year, and held a second congress in Paris last week, when the questions discussed were the unification of methods of testing tractors and motor-driven tillage implements, the sale of agricultural machinery on credit, and the creation of an organisation to centralise the results of trials that are to be carried out under identical conditions, or, at least, under conditions that will allow of some safe comparison. The creation of this central research organisation was left to the Commission Internationale de Génie Rural, which also held a meeting preparatory to a congress in Hungary in July. Another congress was that organised by the Union des Exposants de Machines et d'Outillage Agricoles, which brought together engineers and farmers, and the discussions on the papers showed the interest which agriculturists take in the adaptation of machinery to their needs and the appreciation with which manufacturers accepted some of the suggestions offered. The meeting was of value to both sides, and it inaugurated a collaboration between farming and engineering which is certain to produce good results.

These collective efforts, both technical and commercial, to associate agriculturists more directly with agricultural engineering, imply a systematic expansion of the manufacturing industry on the Continent. In Germany and France it has developed considerably, though it is now in a state of prostration through the phenomenal decline of purchasing power amongst agriculturists all over Europe and through the refusal of French farmers to buy anything until their grievances are redressed. The possibilities of production, nevertheless, exist, and will always be an important factor in the world competition for business, but, as European agriculture will have a huge power of machinery absorption in prosperous times, agricultural engineering is not necessarily threatened with an unwieldy output. It is possible that with a tendency towards specialisation, following upon the opening up of new channels of machinery consumption, the industry will be subdivided and canalised to a greater extent than it is at present. No maker of thrashing machines, for example, can supply all the types that may be required. The number of such types of machine tends to increase, and as new classes of users are brought in all over Europe, there will be a greater specialisation and subdivision of manufacture. For the moment, there is, of course, an over-production of implements and machinery. At the Paris Show there was evidence of the distressful experience through which foreign makers are now passing. There was less initiative in presenting new machines and improvements, and the Show indicated, in a general way, that manufacturers could do little more than hold on and wait for better times. So far as France is concerned, the prospects are more favourable than they are elsewhere, for if agriculturists are able, under cover of wheat import quotas that amount almost to prohibition, to secure measures to stabilise the price of grain, there is no reason why the purchases of machinery should not become normal again.

There has been a demand for oil tractors which are being increasingly employed. They are supplied mainly by German and British firms, the latter having secured an appreciable share of the business during the past year or two, and the British participation was noteworthy in many sections at the Paris Show. More interest has been manifested in the harvester-thrasher even in France, as distinct from North Africa, where there is a good market for that type of machine, and as agricultural labour is always scarce except when imported, the opportunities for business expansion in machinery are considerable. The chief need is for power machinery on small farms. The efforts to produce small universal types of tractor have not met with the success anticipated, owing largely to the relatively small margin between the production costs of small and medium-powered tractors, and, notwithstanding the encouragement offered, and the investigations made, by the Office International de Culture Mécanique at Lausanne, the problem of a power machine for small farmers is still awaiting solution. It must be found if the small farming industry is to be carried on in competition with the big agricultural estates. The whole future of agricultural engineering depends upon a readjustment of the conditions under which agriculture will be carried on. Small farms in France are so numerous that their number is unknown. A census was taken of small farms in the Centre, and the number was found to be about 270,000, and as this would represent probably about a fifth of the total area the importance of small farming may be roughly estimated. Whether the small farmer will use power machines of his own, or will have his work done on the co-operative system, or by contractors, depends upon what the agricultural engineer can offer him. In Germany the big estates have utterly failed for financial reasons, and a movement has been started to cut them up into holdings, so that here, again, the conditions of the agricultural engineering industry are undergoing a change. It is only when agriculture has settled down, and the engineer can see exactly what he is required to supply, that the farm machinery industry will go ahead, and there is every reason to believe that a general mechanisation of farms will bring sustained activity to machinery makers.

SIXTY YEARS AGO.

IT seems credible that the fate of many inventions is still determined by the same circumstances as those which attended the demise of a donkey pump, concerning which we wrote in our issue of January 31st, 1873. The pump was of a very neat design and had been invented by an engineer of some talent. He invited his friends to see it, and for the most part they were enthusiastic concerning its merits. Nevertheless, nearly everyone wound up by saying that the pump was "exactly the thing for a steam fire engine." The inventor knew very well that however suitable his pump might be for feeding boilers, it was not in the least suited for a steam fire engine, and accordingly, disgusted with his friends' opinions, he asked a man on whose judgment he placed much value, to see the pump in operation and appraise its merits. This gentleman went thoroughly into the design and construction of the pump and reported unfavourably upon it on the score of its cost of manufacture. With the object, however, of taking away the sting from this adverse opinion, he concluded by stating that "although the invention could never be made commercially successful as a donkey engine, it could be applied with much advantage as a steam fire engine." The inventor, we recorded, thereupon abandoned his patents and turned his attention to something else. Many inventors, we wrote, were troubled in the same way. They were liable to be beset by a host of friends, who would suggest applications for the idea embodied in the invention in defiance of the inventor's intentions, and in spite of his conviction that such applications would prove impracticable. Bessemer's swinging saloon for preventing sea-sickness among cross-Channel passengers was, so we wrote coming to the point, likely to suffer some such fate. It had not, at the time of writing, actually been tried, but already a host of applications of the system were being talked about, and there was a prospect that the saloon would be swamped by the sea of suggestions that rolled about it. We drew particular attention to the proposal made by Lieut.-Colonel Strange in a paper read before the Royal United Service Institution, entitled "On the Bessemer Saloon, as applied to Training Guns at Sea." The title, we think, sufficiently explains Colonel Strange's idea. We need only add that the guns which he proposed to mount on the stabilised platform were to be Bessemer's own guns, each capable of discharging a 5-ton projectile. We did not believe that Bessemer himself believed that the proposal was practicable, and we expressed our relief at the fact that during the discussion on Colonel Strange's paper the high character of the Royal United Service Institution had been maintained by the complete manner in which the proposal had been demolished. Our own arguments against the scheme need not be repeated. They were not, in actual fact, so sound or conclusive as to leave no loophole for the revival within recent years of the idea of providing a stabilised platform for the guns of warships.

SHORT NOTICES.

Fourth Report on the Heterogeneity of Steel Ingots. 8vo, pp. 204, with XLII. plates. Price 16s. Published by the Iron and Steel Institute, 28, Victoria-street, London, S.W.1.—This Fourth Report on the Heterogeneity of Steel Ingots embodies the results of the work during the past three years of the Joint Committee of the Iron and Steel Institute and the National Federation of Iron and Steel Manufacturers, carried out with the assistance and support of the Iron and Steel Industrial Research Council. Details of a study of twenty-seven ingots are presented, the whole work being divided into the following sections:—Section I., A Further Study of Steel Ingots. Section II.: Oxygen and Silicates in Steel. Section III.: The Distribution of Silicates. Section IV.: Principles Involved in the Making of Rimming Steel. Section V.: Pyrometry as applied to Liquid Steel. Section VI.: Ingot Mould and Materials. Part I., Thermal Properties of Ingot Mould Irons; Part II., The Thermal Conductivities of Ingot Mould Irons. Section VII.: Some Further Mathematical Considerations Concerning the Cooling and Freezing of Steel Ingots. Section VIII.: Bibliography. Section I. contains records of the conditions of manufacture of the ingots and a discussion of the results of their examination. In Section II. a brief account is given of the hydrogen reduction method for the determination of oxygen in steel and a discussion of the oxygen in the silicate inclusions disseminated throughout the ingot. Section III. deals in greater detail with the non-metallic silicate particles, their distribution and composition. Section IV. is devoted to a detailed study of the principles underlying the manufacture of rimming steel. Section V. contains the report of a sub-committee appointed to study the accuracy of pyrometric measurements at steel-making temperatures. In Section VI. the study of ingot moulds is elaborated from the standpoint of the physical characteristics of the mould material. Section VII. consists of a development of the mathematical treatment of the problem of the distribution of temperature in the cooling ingot. The experimental work carried out during the past three years proves that the presence of non-metallic particles and ghosts in the ingot is largely governed, not only by the principles of manufacture, but also by the conditions of melting and refining in the furnace, the condition of the finishing slag at the moment of tapping, and the manner of addition of the deoxidants. The programme illustrates, besides the effect of the temperature of the mould, the size of the nozzle, the rate of teeming and the choice of deoxidants upon the heterogeneity of the ingot, and the position is now reached at which it is possible to control with a certain degree of precision the segregation inevitably associated with even the best ingots produced in modern practice.

The "Practical Engineer" Electrical Pocket Book and Diary, 1933. Edited by Conrad Arnold, A.M.I.E.E. *The "Practical Engineer" Mechanical Pocket Book and Diary*, 1933. Edited by E. G. Beck, A.M. Inst. C.E., &c. London: Oxford University Press, Amen House, Warwick-square, E.C.4. Price 2s. 6d. net each.—These two handy little reference books have again made their appearance, and will be found as practical and useful as in previous years. In the former, among the sections which have been revised are those dealing with Electric Traction, Electric Transformers and Converters, and the main features of the trolley bus system now in use in many districts are outlined. Particulars are also given of the modern oil-electric system of traction. In the "Mechanical Pocket Book" the sections on Steam and Pyrometry have been rewritten and some alterations have been made in the information relating to Fuel Oils, Gas and Friction Linings for Clutches. We have no doubt that these little volumes will prove as useful to practical engineers as their predecessors.

Drainage and Sanitation. Fourth edition. By E. H. Blake. London: B. T. Batsford, Ltd. Price 15s. net.—Many books have been published dealing with the special branches of drainage and sanitation, but this work has become a standard volume covering in a concise and compact manner the whole subject. The author's way of dealing with the general principles and types of apparatus has prevented the book from taking the form of a trade catalogue. The new edition is practically the same as its predecessors and as a standard text-book, we are sure, will justify its reappearance.

Ring Main Feeder Protection

Non - Pilot Systems.

By "NORTH-EAST COAST."

THE protection of ring and radial feeder networks by means of a protective system which does not involve the use of pilot wires appears at first sight to be a simple problem. There are several systems available for selection each of which possesses its own particular characteristics which make it more or less suitable for any given set of circuit conditions. It is often found in practice that a system which proved perfectly satisfactory under one set of circuit conditions is quite unsuited to protect the same circuit when, owing to some external reasons, the circuit conditions have changed. This is not due to any failure of the protective gear, but is attributable to the fact that a limit to the principle upon which the apparatus operates has been reached. It is clear therefore that before protective equipment can be selected for any particular duty, a clear understanding of the principles upon which the various systems operate and the practical limitations set by the circuit conditions are essential. The following notes deal with this aspect of the subject and define the limits which characterise the available systems of protection.

Principles of Operation.—The systems used by various manufacturers for the protection of ring and radial feeders may be divided into two generic classes :—(*a*) Unidirectional or directional overcurrent systems ; (*b*) balanced systems. The first type of equipment involves the use of relays which depend for their operation upon the magnitude of the current flowing or the direction of its flow. The second type employs relays which compare one current with another and operate when the current completes its circuit by any but the recognised route. There are therefore three distinct types of relay required :—(*a*) Overcurrent relays ; (*b*) directional overcurrent relays ; (*c*) balanced relays. It is shown later that the ability of the protective equipment to afford adequate protection depends upon the characteristics of the relays employed.

Necessary Characteristics.—The protective relays have to be designed to embody certain fundamental characteristics upon which the efficiency of operation depends :—(*a*) To give sensitive and stable operation under fault conditions ; (*b*) to isolate the faulty circuit or apparatus as rapidly as possible ; (*c*) to operate in a discriminative manner so that healthy portions of the system are undisturbed during fault conditions. The user of protective equipment will be familiar with these characteristics, but may not be cognisant with the limits which control—(*a*) the value of fault settings that can be used with safety ; (*b*) the maximum time that can be permitted before the fault is cleared ; (*c*) the discrimination required for given circuit conditions. The limits which control these factors are briefly enumerated below.

Fault Settings.—In the early days of protective gear the relays were designed to give as sensitive settings as possible, with a view to isolating the fault from the system in its incipient stages. Considerable difficulty was, however, encountered owing to the instability of the relays with faults outside their immediate zone of protection. Experience on E.H.T. networks has shown that faults are inevitably associated with large currents and the isolation of a circuit in the incipient stages of a fault is not only difficult but is also often undesirable. The question is not, as is generally supposed, to decide how low the relay setting may be, but rather how large the setting may be conductive with safety. The use of a highly sensitive relay has, in consequence, been found in many cases unnecessary and a correspondingly simple, reliable and stable relay has resulted. The maximum permissible setting of the relays is found to be fixed by the value of the minimum short-circuit current which can flow in the system when the smallest amount of generating plant is connected to the system.

Speed of Operation.—It is essential to isolate the disturbance created by a fault as quickly as possible from the healthy portion of the system. Whatever system of protection is used, there will always be an appreciable, though short, period of operation, and it is very difficult to decide upon a maximum permissible value for this figure.

The limiting period is fixed by the synchronous plant connecting to the system, since the disturbance created by the fault must be removed before the synchronous machines connected to the system fall out of step. The time taken for this to occur depends upon a very large number of variables and cannot be generally stated. From experience it has been found that a maximum setting of 2–3 seconds can be adopted in the majority of cases with satisfactory results. An improvement in the time which elapses between the occurrence of the fault and its clearance by the relay is, of course, a distinct advantage.

Discrimination.—One of the most important characteristics of modern protective gear is its ability to discriminate between normal and abnormal circuit conditions and also to operate only upon faults which occur in its own particular also to operate only upon faults which occur in its own particular zone of protection. This property is referred to as "selectivity" or "discrimination" of the protective system. Discrimination is generally obtained for the non-pilot wire systems used to protect ring and radial feeder networks by means of either of the two following methods :—(*a*) Time grading of relays ; (*b*) comparison of currents in different circuits. The use of these methods for obtaining the selective operation of relays is considered later. It should be noted that the use of time grading to obtain discriminative operation introduces a time lag in clearing a fault, but this drawback is not met with when the alternative method is employed.

Types of Circuit.—The various types of circuit conditions which are encountered upon ring and radial feeders systems can, for the purposes of protection, be divided into the following groups :—Group 1 (Single Radial Feeders) : (*a*) comprising feeders supplying a single circuit, such as a machine (see Fig. 1) ; (*b*) comprising feeders supplying several branch circuits, as in the case of the supply to a sub-station (see Fig. 2). Group 2 (Parallel Feeders) : (*a*) comprising two or more radial feeders in parallel (see Fig. 3) ; and Group 3 (Ring Main Feeders) (see Fig. 4). The protective requirements of these circuits are briefly as follows :—

Single Radial Feeders.—The circuits covered by Group 1 require overcurrent protection only, but the relays used for this purpose require two distinct characteristics to enable them to provide the discrimination necessary. In the case of feeders supplying a single circuit, such as a machine, the relay has to discriminate between prolonged overloads of a dangerous character and those of a transient character which may be due to starting from cold, and do not require relay operation. The relays used to protect feeders which supply several branch circuits, as in the case of the supply to a sub-station, are connected in series with other relays of a similar type. Such relays have to operate in a discriminative manner so that the fault at the end of the branch feeders, as shown in Fig. 2, operates the relay nearest the fault only. To enable the relays to discriminate in this manner it is necessary for them to have an inverse time characteristic which enables the relay to discriminate between a prolonged dangerous overload and one of a transient character. An adjustable definite time of operation is also required to enable the time of settings of the relays to be graded in their time of operation. A fault at the end of a branch feeder operates the relay nearest to it only and other relays located closer to the power station remain inoperative owing to their longer time setting. This is an example of the use of time grading to obtain discrimination.

Parallel Radial Feeders.—Parallel radial feeders are generally provided to enable the supply to be maintained in the event of a fault in one feeder. The relays required for feeders of this type have to possess discriminating characteristics which will enable (*a*) a fault in one feeder to be isolated without affecting the healthy feeders ; (*b*) stability to be maintained upon heavy through fault currents occasioned by a fault on circuits in series, but more remote from the power station ; (*c*) stability to be maintained when, owing to a fault elsewhere on the system, the bus-bar voltage drops and the synchronous machinery feeds back into the system.

The two main systems of protection available for parallel feeders of this type are shown in Figs. 5 and 6. The system shown in Fig. 5 is the overcurrent type and employs overcurrent relays at the sending end and directional overcurrent relays at the receiving end. In the event of a fault in feeder A the directional relay at the receiving end operates first. The whole of the fault current then passes through the one overcurrent relay at the sending end only, which operates and isolates the faulty feeder. The system shown diagrammatically in Fig. 6 operates upon the balanced principle. The current flowing outward from the power station divides between the parallel feeders in the inverse ratio to their impedance. Under normal conditions the currents in the parallel feeders will bear a fixed relation to one another. If a fault occurs in one feeder this balance is upset and the protective relay has to select and isolate the faulty feeder. Balanced relays are used for this purpose, which compare the currents flowing in the feeders and operate when the current distribution among the feeders changes. The balanced relays at the sending end and directional balanced relays at the receiving end are shown diagrammatically in Fig. 6. The overcurrent relays shown at the sending end take control when only one feeder is in commission.

Ring Main Feeders.—The ring main feeders covered by Group 3 are generally protected by means of overcurrent and directional overcurrent relays, as shown diagrammatically in Fig. 7. Overcurrent relays are provided on each side of the sub-station and are set to operate when the current leaving the sub-stations exceeds a predetermined amount. These relays are all graded in their time of operation in such a manner that a fault between any two sub-stations operates the relays on each side of the fault only.

Limitations of these Systems of Protection.—The application of these general considerations to practical cases is not nearly the simple matter it might appear. Even in the simplest cases of single radial feeders practical circuit conditions demand great care in selection. In certain cases the relay characteristics only have to be considered, while, in other cases, the principles of the particular system of protection also have to be taken into account. In a general manner the limitations set by practical circuit conditions are briefly as follows.

Single Radial Feeders.—The selection of equipment for the protection of feeders which supply single circuits, such as a machine, involves a consideration of relay characteristics only. The relays used must be capable of discriminating between the overloads which occur owing to normal and abnormal running conditions. In many cases no difficulties occur at all. On the other hand, it is by no means uncommon to meet with machines which have extremely heavy starting conditions, and which, at the same time, require protection against comparatively small overloads which are sufficiently prolonged as to be dangerous. It may be necessary for the protective equipment to operate with, say, 30 per cent. continuous overload and to remain inoperative for 500 per cent. starting overload for 30 seconds. Such conditions are severe, but serve to show that a careful check must be made when protecting relays are being chosen. When equipment has to be selected to protect a single radial feeder supplying several branch circuits, such as the supply to a sub-station, it is necessary, in addition to the above considerations, to check the time settings involved. For example, if a maximum time setting of three seconds is adopted, allowing ½ second between each relay connected in series, four relays only can be graded. If more than this number of relays is required con-

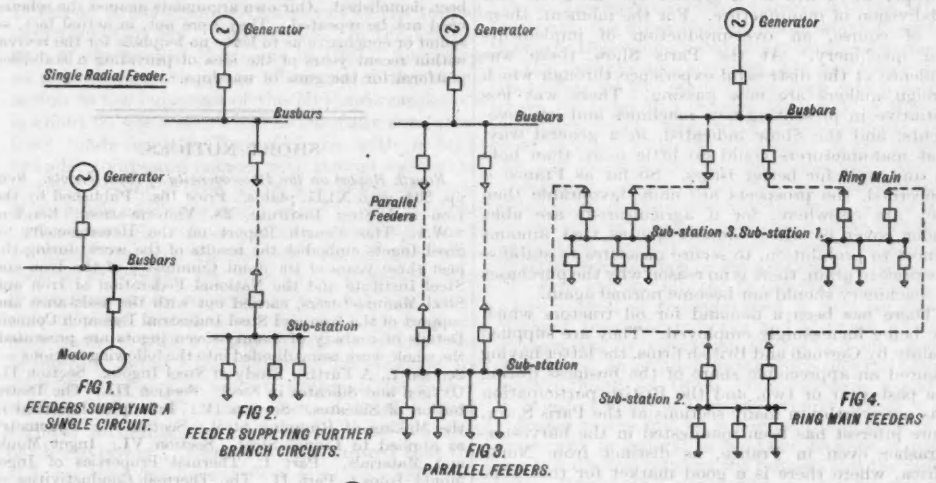


FIG 1. FEEDERS SUPPLYING A SINGLE CIRCUIT.

FIG 2. FEEDER SUPPLYING FURTHER BRANCH CIRCUITS.

FIG 3. PARALLEL FEEDERS.

FIG 4. RING MAIN FEEDERS

FIG 5. PARALLEL FEEDER PROTECTION. (OVERCURRENT TYPE).

FIG 6. PARALLEL FEEDER PROTECTION. (BALANCED TYPE).

FIG 7. RING MAIN FEEDER PROTECTION. (OVERCURRENT TYPE).

"THE ENGINEER"

RING AND RADIAL FEEDER CIRCUITS

nected in series, some other form of protection will probably have to be used.

Parallel Radial Feeders.—When the overcurrent system of protection is used, the characteristics of the relays have to be carefully considered in the manner already described. In this case the time and current settings obtainable also have to be carefully considered before it can be decided whether the system is capable of giving efficient protection under the particular circuit conditions that obtain. Since the relays have to be graded in their time of operation with other relays connected in series, there is a definite limit to the number of relays that can be so connected without making the time settings too long. The time settings of the directional relays at the receiving end of the line which have to operate first have to be set at a value that will enable the synchronous plant to feed back without operating the relays. The synchronous plant may in extreme cases feed back anything up to four and five times normal full load, making the relay settings correspondingly high. The overcurrent relays at the sending end of the feeders will have to be set slightly higher than the directional relays.

If taking the case of two parallel feeders each cable is capable of taking the total load, then under normal conditions with both feeders in commission, the relay settings may, for reasons of stability, be so large that, under conditions of minimum generating plant in commission, the short circuit current is not sufficient to operate the relays. When such conditions obtain it is necessary to use some other form of protection and the balanced system suggests itself. The balanced system is not affected by the feeding back of synchronous machinery, but when one of the parallel feeders only is in commission, the overcurrent relay takes control with all the attendant limitations described above. The ring main system of protection generally employed and shown in Fig. 7 operates upon the overcurrent principle, using time grading for discrimination purposes, the limitations of which have already been described. The factor of vital importance which limits the use of the overcurrent system is the ratio of the short circuit current when the maximum and minimum of generating plant are connected to the system. The advantage offered by the balanced system, which enables settings of less than normal full load to be obtained and does not require graded time settings, is considerable, but, unfortunately, disappears when only one feeder is in commission. Happily, the characteristics of most industrial systems are such that the overcurrent and balanced systems of protection can be, and are, used with great success. Nevertheless, the limitations to which they are subject must be carefully considered before an installation is made. Since they do not in any way affect the general principles involved, no mention has been made of the use of cross-connected current transformers, biassing effects, &c.

Coal and Oil.*

By JOHN BRASS.

THE coal industry, and indirectly mining engineers, have recently been the subject of criticism from many quarters for neglecting to carry out research work on coal on an extensive scale, but I submit that those who have taken upon themselves the functions of critics have scant knowledge of the research work which is being carried out, either directly by the industry or by the industry in collaboration with other bodies. There appears to be a feeling that little is being done because our industry does not maintain a large central establishment for research work. Nothing can be further from the truth, and, I think I am right in saying, that in no industry is there more research work done or more money spent on it than in the coal industry, whether it be in the direction of the knowledge and utilisation of our products or concerning the health and safety of the workers.

There are many outside our industry who, from mercenary motives or from altruism, have prematurely or falsely interpreted the results of research; who pose as competent advisers, and are accepted as such by the public. In consequence, the public have been gravely misled on many occasions. The industry has suffered much from such interference, and has been blamed unjustly for apparently ignoring schemes which, to the misinformed, seem to have obvious potentialities. It has yet to be proved that we have failed to take full advantage of any results of research which could have been utilised with benefit to the coal industry. On the other hand, where it has been shown by those whose competence is beyond question that advantages are to be derived from the investigation of any particular discovery, we have earnestly applied ourselves to the problem.

There is to be found in the "Transactions" of this Institution an enormous amount of valuable information, which is available to all who are sincere in their desire to purchase and use coal scientifically, but I am afraid that those who wish to do so form but a small proportion of the consumers of fuel. The usual procedure in purchasing coal is to order sample trucks. In the event of the coal proving only approximately suitable for the consumers' requirements, but if the price is somewhat less than that which was previously paid, then the coal is approved. The deciding factor usually is the price.

The buyers in the majority of large industrial concerns have had no technical training, and have but small knowledge of the advance that has been made in the assessment of fuel values. When other industries realise the advantages to be gained by the purchase of fuel on a scientific basis, they will find mining engineers, and the coal industry generally, fully equipped and ready to sell fuel on this basis. There is sufficient evidence to show that if there are faults, they do not lie so much at the door of the coal producers as at that of the consumers.

The coal industry promotes research in many directions. Through the Miners' Welfare Fund about £100,000 per annum is being contributed for research and mining education. In addition, large grants are made directly to the technical universities by the British Coal Owners' Research Association and by the Coal Owners' Associations of the respective districts.

Recently the Mining Association of Great Britain, in conjunction with the Coal Merchants' Federation and the National Council of Coal Traders, constituted a Coal Utilisation Council, which has for its main objects the furtherance of the use of coal and its proper application. I am assured that the Coal Utilisation Council will welcome our assistance.

Of the many schemes evolved for the utilisation of coal, the most popular at the moment is that of its conversion into oil by means of the hydrogenation process. Great advances have been made in the technique of this process, but, whereas the Germans found it comparatively easy to treat brown coal successfully, they discovered that bituminous coal did not respond so readily. In this country Imperial Chemical Industries, Ltd., have conducted experiments for some time past on a fairly large working scale, and have definitely proved that high-grade petrol can be obtained by the hydrogenation of bituminous coal.

We import 1,000,000,000 gallons of petrol per annum, and, at first glance, it appears obvious that we should obtain this from our own coal, thereby creating employment, improving our trade balance, and rendering ourselves independent of outside sources for our supplies of petrol. On closer examination, however, it is not easy to determine whether the benefits to be derived from the hydrogenation of coal outweigh the drawbacks. At present, so much interest is being taken in this subject, that I have endeavoured to analyse the position as it presents itself to me, from facts already published.

As previously stated, approximately 1,000,000,000 gallons of petrol are imported annually; 13,000,000 tons of coal would be required to obtain this quantity, and £142,000,000 would have to be spent to provide the necessary plant. On this basis, permanent employment would be provided for 104,000 hands, of whom nearly 55,000 would be employed in and about the mines. The capital expenditure for each person permanently employed would amount therefore to £1362.

In dealing with this question it must not be overlooked that considerable unemployment would be created amongst British seamen, dock workers, shipyard workers, and all those connected with the shipping of oil, if all our petrol were to be obtained by the hydrogenation process. The loss in revenue to the Government would amount to the serious total of £33,000,000 per annum at the present rate of taxation, or expressed in other terms, it is equivalent to a sum of £317 per annum for each person for whom employment has been found by these means.

The cost of delivering petrol into storage at British ports is in the neighbourhood of 2d. per gallon, whereas the cost of its production by the hydrogenation process is approximately 7d. per gallon.

It is unfortunate that up to the present time none of the oil obtained from coal by any process can take the place of imported fuel oil for use in Diesel engines.

I have felt compelled to mention this subject because mining engineers and the coal industry have been berated for not accepting the hydrogenation process promptly and enthusiastically, but it will readily be seen that, apart from the reduction of revenue to the Government, unless the petrol tax is maintained at a comparatively high level, definite and perhaps serious losses will be incurred.

It has been stated by irresponsible persons that the industry has neglected this means of salvation. But what are the facts? The potential output of coal in Great Britain is estimated to be over 300,000,000 tons per annum, the output for the year 1931 was 224,000,000 tons, so that there is an excess productive capacity of at least 76,000,000 tons per annum. Since the estimated consumption of coal would be 13,000,000 tons per annum if all our petrol requirements were supplied by means of the hydrogenation process, only 17 per cent. of our excess productive capacity would be absorbed.

* The Presidential Address to the Institution of Mining Engineers, Wednesday, January 25th, 1933.

American Engineering News.

Oil and Petrol-electric Excavators.

ELECTRIC excavators, obtaining current by flexible cables connected to a neighbouring transmission line, or other source of supply, are in extensive use in the United States, and have been developed into machines of exceptional size and power. Electric operation of such machines has important advantages, and to make it available on work distant from any source of current supply or distribution, the petrol-electric and oil-electric excavator has been introduced, including both the shovel, or "navvy," type, and the drag-line type. It is more complicated than the plain electric machine, and the maintenance expense of the engine is rather high, but the higher operating charges may be partly offset by the absence of charge for electric power. The machine has greater mobility in addition to its independence from transmission lines, and the consequent absence of cable connections, switches, transformers, &c. The engine-driven generating equipment is larger than for a comparable electric machine, and the speed is lower, about 1800 revolutions. Otherwise, the characteristics are very much the same, as will be the controllers, D.C. motors, and other electric equipment. The exciter, however, will usually be belt-driven, and if an air compressor is used, it will be built into the engine. Owing to the size and arrangement of the engine and direct-connected generator, the control is usually of the rheostatic type, which is more compact than the Ward-Leonard type, although designs of this latter have been made with a special view to use on petrol-electric and Diesel-electric machines. Owing to the series of successive high peak loads in excavator operation, the machines must be over-powered and so designed that the maximum possible peak loads will not be in excess of the maximum engine power. Both large and small excavators of this type have been built.

Molybdenum in Tool Steels.

In a recent discussion on "high-speed" tool steels, it was stated that the Ordnance Department of the United States Army has found molybdenum a very satisfactory substitute for tungsten. This is important, since tungsten is classed as a "strategic material." After extended tests, including forging, rolling, and heat treatment, orders were given for some 10 tons of molybdenum tool steel of the following specification:—Carbon, 0·65 to 0·75; molybdenum, 9·25 to 9·75; vanadium, 1·15 to 1·35; chromium, 3·25 to 3·75; manganese, 0·15 to 0·75; silicon, 0·15 to 0·25; sulphur, maximum, 0·025; phosphorus, maximum, 0·025. The steels were distributed among the different arsenals, where they were made into various tools whose performance was studied and recorded. Shop tests included work with both light and heavy tools on drilling machines, lathes, milling and reaming machines. Corresponding tests were made with tools of tungsten steels and tungsten-cobalt steels. On planers and lathe work the tools of molybdenum steel proved to be equal to or even better than the others. Prior to the tool tests, the steel as supplied by the manufacturers was subjected to rigid inspection tests, which it stood satisfactorily. The manufacture of the steel and its production in the specified shapes did not cause as much trouble as had been feared, and, in fact, it is stated that the makers were agreeably surprised at the relative ease of manufacture under the specifications. The sizes ranged from ¾in. to 6in. diameter, in bars of various shapes or sections. In these investigations and tests there was complete co-operation between the Army engineers and the steel manufacturers, the former in particular furnishing full information as to results of the extended investigations carried on before the placing of the contracts.

Boring 10ft. Wells.

With the increasing use of concrete cylinder piers as foundations in soft ground for American bridges and buildings, there has been developed machinery for boring holes, 4ft. to 10ft. in diameter. In the earlier structures the open wells were sunk in lifts of about 5ft., each lift being lined with vertical tongued-and-grooved wood staves, supported by interior ring braces of steel. More recently, concrete staves have been used, with radial faces, so as to form a solid circle which does not require bracing. In Chicago, such wells have been sunk as deep as 120ft. to reach rock. Where lighter loads warrant seating the piers in shale, above the rock, the base of the pier is belled out conically to increase its bearing area. In one form of boring machine, a powerful derrick mounted on crawlers has at its forward end a large worm gear, which revolves a vertical hollow steel shaft built up in sections with flanges and bolted joints. At the bottom this shaft carries a cutter head of the required diameter. Water is pumped down the hollow shaft and flows up the well to overflow. When the desired depth is reached, the shaft and cutter are withdrawn and a cylinder of plain or corrugated steel is lowered to prevent caving, while the well is pumped out and concrete is poured into it. A different type of machine designed for use in the dry, has a telescopic shaft, at the bottom of which is a cylindrical bucket having the top closed and the bottom fitted with cutters or blades. The capacity of the bucket is about 1 cubic yard. As the bucket revolves and feeds down, the cutters excavate the material and force it into the bucket. When loaded, the cutters fold inward to close the bottom of the bucket which is then raised above ground. A wagon or motor truck is backed under it, and the cutters open, allowing the contents to fall out.

Underground Goods Railway.

Recent revival of the scheme for an underground goods railway in London serves to call attention to the extensive system of this kind which has been in operation for several years at Chicago. In this case, however, the lines are of narrow gauge, 24in., forming a rectangular network under the streets, with diagonal connecting curves at many of the intersections. The concrete-lined tunnels are about 6ft. wide and 7ft. high, of horseshoe section. Studies by the original projectors showed such a dense occupation of the ground beneath the streets by sewers, gas, and water mains, electric conduits, and other public utilities, that the idea of a shallow-depth subway system was abandoned, especially as the proposed underground rapid-transit or tramway tunnels would extend even deeper than the complicated series of utilities. They wisely, therefore, decided upon a deep-level system, with the rails 40ft. to 45ft. below the street level. This system as it now exists has 65 to 70 miles of line, operated by electric locomotives taking current from overhead wires. It serves railway goods stations, warehouses, manufacturing establishments, and many of the multiple-story office buildings. Besides handling goods to and from the railway stations it delivers coal, removes ashes, and hauls away *débris* from excavations and building operations. At railway stations the cars are raised to the surface by electric elevators or lifts, and travel on tracks laid along the platforms. This practice is followed at some establishments. In other cases sidings are laid into low-level subbasements for handling goods or to deliver coal and remove ashes at boiler-rooms and power stations.

Train-ferry Extraordinary.

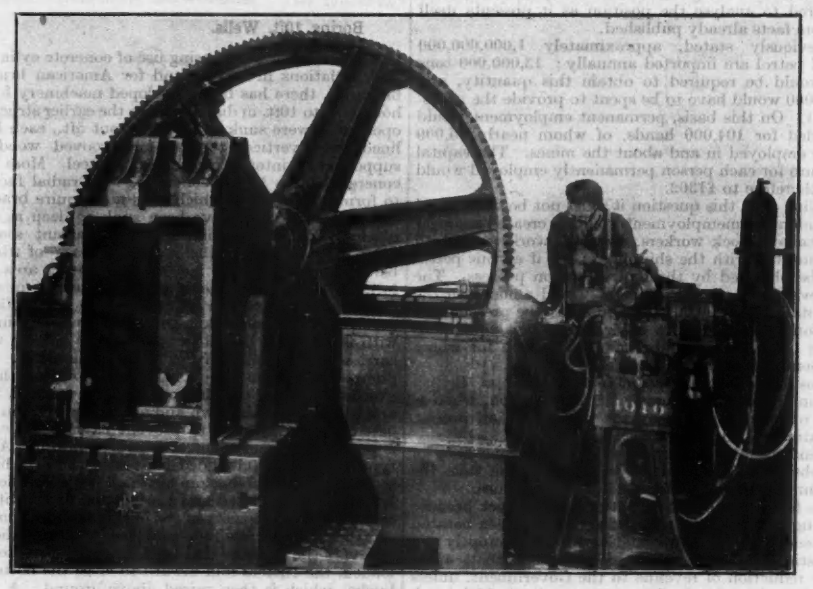
A four-day voyage of goods wagons from New York to Cuba was started recently, to supplement the three-day voyage from New Orleans to Cuba. This latter service has been in operation for some time with a steamer that was built in England. For the new service two larger and much more powerfully engined vessels have been built by the Sun Shipbuilding Company, at Chester, U.S.A. Their scheduled time is four days from New York to Havana, and thence two days to New Orleans, each boat making the round trip in two weeks. The advantages are largely in the saving in time and cost of handling goods, as compared with transferring goods from cars to ships and again from ships to cars. Each steamer has four lines of rails on each of four decks, with total accommodation for 100 cars of 40ft. to 45ft. length. On the wharf is a steel tower with a moveable platform or cradle. A car is shunted on to the cradle, which is then raised, run out by trolleys on an overhead jib, and lowered into the hold, where it is pulled off by means of a cable and power capstan. The two new ships are 478ft. long, 63ft. 6in. beam, and 38ft. 6in. deep below the main deck, and have a displacement of 13,745 tons on 23ft. draught. Three water-tube boilers burning oil fuel supply steam at 435 lb. pressure or 400 lb. at the turbine regulator; but for the normal sea speed of 16½ miles an hour the

regular pressure will be about 300 lb. The shaft horse-power is 8800 H.P., as compared with 3500 H.P. for the first steamer. There is only one screw, with a diameter of 17ft. 6in.; pitch, 17ft. 9in. It is of manganese bronze, and has four blades. Copper-bearing steel is used for the main and upper decks, and many of the fittings are of stainless steel and welded in place. The engine and boilers are placed at the extreme stern.

Hardening an 8ft. Dia. Gear Wheel.

THE photograph which we reproduce below illustrates the operation of hardening by the "Shorter" process, a double helical gear wheel, 8ft. in diameter, having 180 teeth and 12in. width of face. It was manufactured by David Brown and Sons, of Huddersfield, and hardened by them on a "Shorter" process machine, licensed by the Patent Gear and Metal Hardening Company, Ltd., Westminster.

Some idea of the range of utility of the "Shorter" process, which was described in THE ENGINEER of December 17th, 1926, in the hardening of gears will be realised



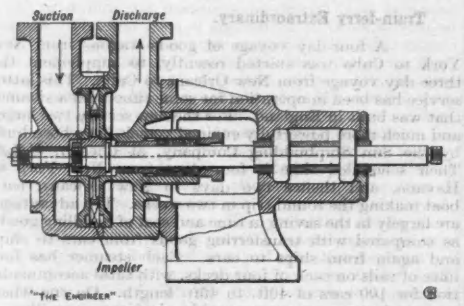
HARDENING AN 8 FT. DIA. DOUBLE-HELICAL GEAR WHEEL

when we say that, not only can large gears such as the one illustrated be successfully hardened, but the smallest gears of 10 diametral pitch can also be treated in the same way. The process is equally applicable to 5in. circular pitch gears and also to the hardening of the teeth of worms. Hitherto it has not been considered a feasible proposition to harden gears of 8ft. diameter having a 12in. tooth face. Such a wheel is costly to manufacture, but at a comparatively small cost its life can be very greatly increased. Apart from the cost of replacement, the cost of handling and stoppage is a matter of importance.

The machine illustrated was originally designed for hardening gears not larger than 6ft. in diameter, but by means of the special rig shown the 8ft. wheel was accommodated. It will be noted that the axis of the wheel is canted over, so as to get the line of the helical tooth parallel with the water surface in the tank, while the oxy-acetylene blow pipe used in the hardening process is mounted on a separate standard. Otherwise the operation of the machine is normal. It is noteworthy that while the "Shorter" process provides the teeth with a hard wearing surface, it is claimed not to distort the wheel at all.

The "Wee-Mac" Pump.

WHEN small quantities of water have to be raised to considerable heights, or forced into chambers under considerable pressure, it is frequently found that the conventional centrifugal pump is not entirely suitable. Under such circumstances the centrifugal pump also labours under the disadvantage that a very slight leakage of air into the suction pipe or the stuffing-box may be sufficient either to cause the pump to fail to deliver or to create unstable working. While the centrifugal pump is at a disadvantage in these respects, the rotary positive displacement pump, though not liable to similar faults has others that make its use inconvenient for certain purposes. In common with all reciprocating machinery, wear of the sliding parts is likely to take place, while in some designs the complication of suction and discharge valves is introduced. The design of the modern rotary or reciprocating pump, however, is such that, although a considerable degree of attention is required, not much trouble is likely to occur. The real disadvantages of the positive displacement pump are its lack of flexibility and its weight. If connected to a constant-speed motor, it gives a practically constant delivery against any discharge pressure.



LONGITUDINAL SECTION OF "WEE-MAC" PUMP

A new pump working on a rather novel principle and designed to overcome the objections of both centrifugal and positive displacement pumps, has been introduced by Drysdale and Co., Ltd., of Yoker, Glasgow. A sectional drawing of the pump is given in the accompanying engraving. The impeller is a plain disc, with a number of blades arranged around the periphery. It rotates inside a concentric casing, which has a wedge-shaped passage on each side of the impeller. The wedge-shaped passage on one side gradually widens until the discharge opening is reached, and on the other side a similar, but opposite-handed wedge-shaped passage gradually increases in area till the suction opening is arrived at. In the working of the pump it is found that the water circulates in each of the blade cells, being given a definite impulse and discharged from this cell into the side passage, where it is taken up by the next bucket, and given a further impulse, and so on, until the discharge orifice is reached. Hence a compound pumping effect is secured in the single impeller equivalent to a multi-stage pump, and the pressure developed is approximately three times the pressure created by an ordinary centrifugal pump of the same proportions, running at the same speed.

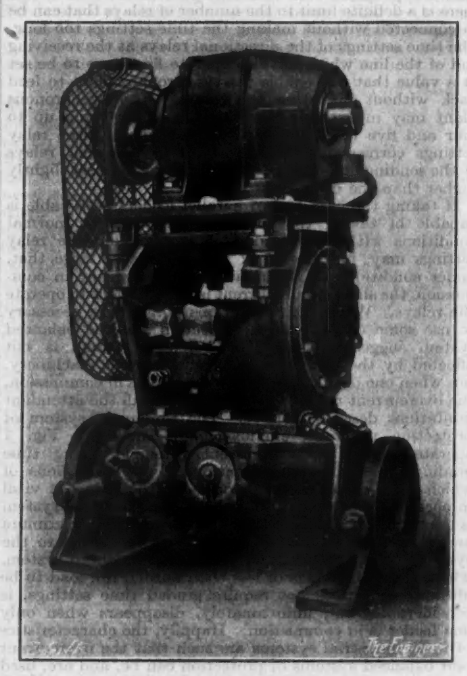
The pump has furthermore the valuable property of being self-priming, and can fill an empty suction pipe, and overcome the possibility of air locks, due to loops or rises in the suction pipe. Tests made by the makers have shown that static suction lifts up to 28ft. are practicable, while if the suction pipe is completely closed, the suction effort reaches 32ft. at sea level and normal barometer.

The pump may be run against a closed discharge valve, and its characteristic is such that the power falls as the flow increases, thus ensuring that the driving motor or engine shall not be overloaded.

Improved Circulating Pump for Hot Water Heating Systems.

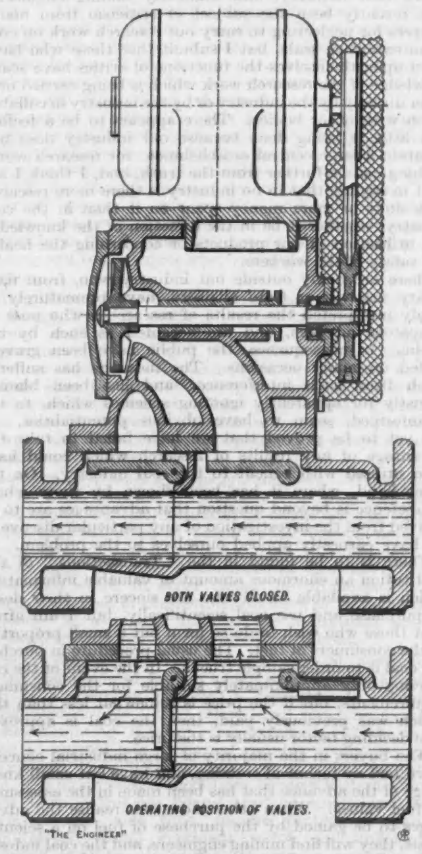
THE employment of some means of circulating the water in hot water heating circuits is usually necessary. Holden and Brooke, Ltd., Manchester, claim to have been the first firm to design and construct a circulating pump expressly to meet the demands of heating engineers. The Selfix circulator, which was introduced in 1926 by this firm, dispensed with the ordinary pump and bed-plate for the pump and motor, and instead the bed took the form of a straight length of piping, which fitted direct into the heating circuit by means of bolted flanges. In addition, the necessary isolation and non-return valves were self-contained and the set, including the electric motor, was a single unit capable of being erected without foundations or other means of support. In this arrangement the centrifugal pump spindle and motor spindle were in alignment and the drive was effected by means of a flexible coupling—an admirable, simple, and efficient method for almost all heating systems, but with the one objection that the magnetic hum of the motor is transmitted to the heating circuit through the medium of the water, which acts as a conductor of sound. In many installations this feature would not detract from its success, but in places of worship, hospitals, and flats it might prove objectionable, and especially so if the motor has not been well chosen for the purpose.

To overcome this defect Holden and Brooke, after prolonged investigation, have designed a new unit called the "Super-Selfix," which, while possessing all the advantages of the earlier model, is claimed to overcome definitely this drawback and to embody other new features. As will be seen from the illustrations, the "Super-Selfix" comprises three separate main parts, namely, the self-contained by-pass, which forms the base, the centrifugal pump, which is mounted above the by-pass—being secured by bolted flanges with ports for the passage of the water—and the motor, which is mounted on top of the pump. The motor, which may be of any suitable make or type, is insulated from the pump by damping pads, and the pump is driven by means of a silent belt, the tension of which can be adjusted by simple means while the motor is running. An improvement has been introduced



SUPER-SELFIX HOT-WATER CIRCULATING PUMP

in the isolating and non-return valve system in the by-pass so that the unit is hydraulically automatic in service, cutting in and out of operation as the motor is switched on and off. Thus when the circulating pump is running the non-return valve automatically closes and prevents back flow of the water, while when the pump is out of operation the non-return valve opens automatically and permits a straight flow of the water through the full area of the pipe bed. Although the modern electric motor and centrifugal pump are expected to run for long periods on end without attention, and generally do so, such items as gland packing and internal inspection are occasionally necessary, and on such occasions some method of isolating the pump and motor from the hot water circuit is desirable. For this purpose a second flap valve is provided in the by-pass, which can be closed by means of a hand wheel shown in the half-tone engraving. The non-return valve is also provided with a wheel and pointer to indicate whether the pump is in operation or not. When the two



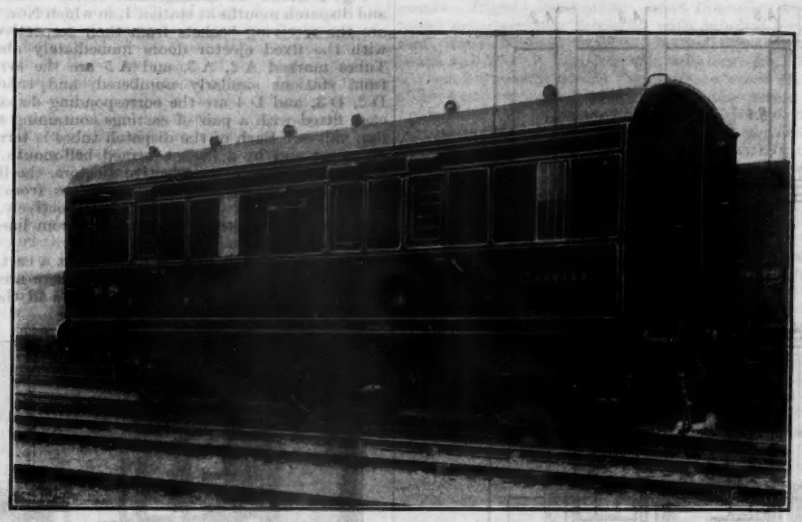
SECTION OF SUPER-SELFIX PUMP SHOWING VALVE POSITIONS

valves are in the horizontal position the pump can be completely removed while gravity flow continues.

The sale and distribution of this appliance are in the hands of the National Radiator Company, Ltd., Hull.

Six-wheeled Steel Brake Vans, L.M.S.R.

A NUMBER of short six-wheeled type brake vans, as illustrated herewith, have recently been constructed by the L.M.S. Railway at its Wolverton Works to the requirements of Mr. W. A. Stanier, chief mechanical engineer. The outside dimensions of these vehicles are 31ft. long by 8ft. 6in. wide by 8ft. 4in. high at the centre of the body, giving an approximate capacity of 280 cubic feet. The

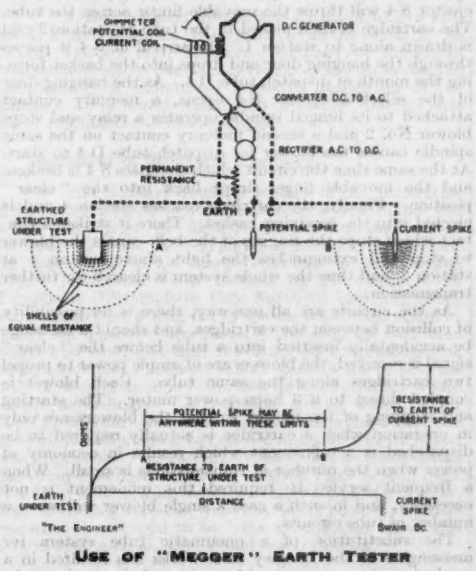


L.M.S.R. STEEL BRAKE VAN

underframe is constructed entirely of steel and is fitted with shock-absorbing buffers and all-steel wheels. Gangways are provided at each end with improved suspension for the flexible part, and these vans can therefore connect up to all types of vestibule passenger vehicles. The bodies are soundly constructed of hard wood framing members, having holes bored at intervals to allow free circulation of air in the sides. Steel outside panels are utilised and the windows are practically flush with the outer surface of the body to facilitate cleaning. Sheet steel projections or look-outs are arranged, one on each side. The sides of the vans are strengthened by continuous steel bands on the extreme lower edge at the waist and above the windows, whilst sheet steel panels finished with steel section side gutters cover the roof. The floors, constructed of dovetail section steel sheets filled in with fireproof material, are provided with drain holes for washing out, and hard wood dumping blocks are placed at the entrance doorways to withstand heavy wear.

Earth Resistance Tests on Transmission Line Towers.

AT the request of the Central Electricity Board, Evershed and Vignoles have recently carried out some interesting earth resistance tests on the transmission



USE OF "MEGGER" EARTH TESTER

line towers for the Thames crossing near Dagenham, and on the smaller towers for the river Roding crossing. The earth resistance of a tower depends on the dimensions of its footing, those of the earth plates used, and the specific resistance of the soil surrounding the tower. Current through the soil is conducted largely by the moisture present and, in consequence of the electrolytic effect, A.C. must be used for resistance measurements. The instrument used for the tests was the "Megger" earth tester, made by Evershed and Vignoles, and shown diagrammatically in the accompanying illustration. One terminal of the instrument is connected to the structure under test, and the other two to current and potential spikes driven into the ground at suitable distances from the structure in the manner shown. Direct current from the generator passes through the current coil of the ohmmeter and through a converter, which is operated by the handle which drives the generator. Alternating current is, therefore, delivered to the current terminals of the instrument and passes through the soil from the earth connection under test to the current spike. Since the potential coil of the ohmmeter obtains its supply from the terminals connected to the earth connection under test and the potential spike, it is made uni-directional before passing through the coil by means of a rectifier mounted on the same shaft as the current converter. The ohmmeter consists of two coils mounted at a fixed angle with respect to one another on a common axle carrying a pointer moving over a scale marked in ohms, and the coils swing in the field of a permanent magnet. The final position of the coils and pointer depends on the ratio of the voltage across the earth under test to the current passing through it, and the instrument is, therefore, a true ohmmeter giving readings independent of the generator voltage. If, after the temporary current spike has been driven into the soil at a sufficient distance from the plate or structure under test, a series of tests is made with the potential spike at varying distances from the plate, a curve somewhat of the shape of that shown is obtained. The first rapidly rising portion represents the resistance of the soil surrounding the earth plate, while the rising portion at the other end represents the resistance of the soil surrounding the current spike, and if the potential spike is driven into the ground at a point where the curve is about horizontal, the true value of the resistance to earth is obtained. As the towers of an overhead line are usually linked together by an overhead wire, it is necessary to disconnect this wire in order to obtain the true resistance to earth of any one tower. Tests on the north tower of the Thames crossing showed that its resistance to earth was 0·08 ohm, whilst with its four earth plates unbolted it rose to 0·11 ohm. Tests on one of the Roding crossing towers with the earth wire left in place, showed that the resistance to earth was approximately 0·10 ohm, the resistance of all the towers being extremely low, owing to the size of the towers and the character of the ground on which they are erected.

Electro-Deposition.

WE would recommend to the attention of those who were fortunate enough to hear the discourse of Dr. Ormandy, at the last meeting of the Old Centralians, the following remarks on "Mist Plating," published in the *Industrial Bulletin* of Arthur D. Little, Inc., of America.

The general principles of electro-plating in which electrodes and aqueous metallic salt solutions are used are most familiar, but few realise the possibilities of plating without these aids. The essentials of this progressing art of "dry plating" are not new, but their general industrial applications are only now being recognised.

The technique is relatively simple. A small piece of the metal with which it is desired to coat an object is placed within a small tungsten wire coil. The coil is connected with a source of current which can be used to heat it and so vaporise the metal in the coil. The object to be plated and the heating coil are enclosed in a suitable air-tight container. This apparatus is then evacuated by a vacuum pump. When the air in the enclosure is practically exhausted the tungsten coil is heated by the electric current to a temperature sufficiently high to cause the plating metal to volatilise. The metal vapours fill the chamber and condense on the exposed surfaces, covering the object and interior of the apparatus with a uniform metallic plate. The thickness of the deposit is governed, of course, by the quantity of metal vaporised.

In the majority of cases the total amount of heat required to vaporise the metal is so small that combustible material, such as cloth, paper, wood, &c., may be metal coated without chemical change.

By this process it is possible to plate objects with nearly all the metallic elements, some alloys, and even quartz. In fact, it is possible to secure deposits of metals unattainable by electrolysis.

Although a process similar to the above has been industrially used to coat the interior walls of "Thermos" bottles with nickel, its application seems to have been limited to this particular field. There appears to be no logical reason why such a process could not be advantageously used to coat any material which will retain its physical characteristics when subjected to a high vacuum. The metallic coatings may be applied to such diverse substances as cellulose derivatives, glass, leather, and many other materials that cannot withstand the chemical reaction of the plating bath. It should be possible to obtain many striking decorative effects, because of the extremely thin deposits that can be obtained by this method. Metallic plates can be made so thin as to be translucent.

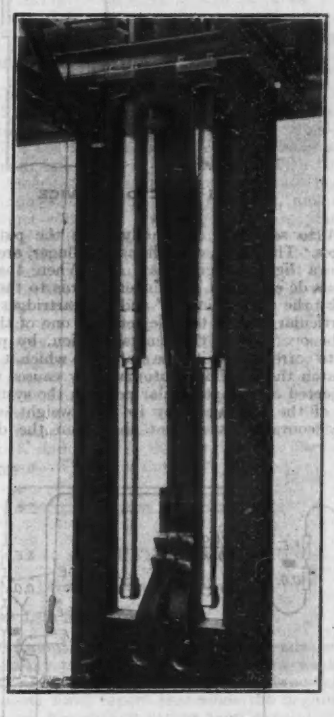
The disadvantages of the process from an industrial point of view seem to lie in the fact that an almost perfect vacuum is required. This necessitates not only gas-tight equipment, but also thick-walled chambers for the processing of large objects, because of the atmospheric pressure. Further, not only the object to be plated, but also the whole interior of the apparatus is coated with the metal. When the ratio of the area of the chamber to the area of the object is large the efficiency of useful deposit is low. However, with common metals, which are cheap, this is not a serious drawback. The process is likely to be more expensive than electro-plating from aqueous solutions.

It would seem that mist plating may have many special applications. This is especially true when the metals are to be deposited on a non-metallic substance or on materials injured by plating baths. The process also widens the field of industrial plating, in that other elements can be advantageously deposited in this manner. Further, unlike electro-plating, the base metal has little or no influence on the character of the metal deposited; in fact, it is possible to "plate" gold directly on an aluminium or zinc base. Last, but not least, mist plating produces almost impervious plates of extreme thinness. It may be that these new mist plating processes have opened the way to commercial applications formerly ignored because of inherent difficulties in plating, or lack of controllable methods.

The Massey Accelerator.

A NEW fitting, known as the Massey Accelerator, for friction drop stamps, which, it is claimed, considerably increases the number of blows obtainable per minute while, at the same time, maintaining the force of the blow, has been recently introduced by B. and S. Massey, Ltd., of Manchester.

As shown by the illustration, the accelerator is a simple device, easy to fit either to new or existing stamps. It



THE "MASSEY" ACCELERATOR

consists of two compact cylinders placed between the slides, one on each side of the lifting belt, and supported from the girders. A stout piston-rod projects downwards from each cylinder and as the tup is lifted it comes into contact with these rods and forces them up into the cylinders, compressing air above the pistons. An air buffer is arranged at the lower end of each cylinder so that the rods are prevented from following the tup down through the last few inches of its stroke. They are thus shielded from the shock of the blow. Only a small supply of compressed air is required, and a one-way valve is provided to compensate for leakages. The energy stored up in compressing the air on the upstroke is utilised to increase the velocity of the fall, and whilst the maximum stroke of the stamp is nearly halved the force of the blow is maintained. The shorter stroke and the quicker fall, it is claimed, make it possible to increase considerably the number of blows per minute. The makers state that in the case of a 15-cwt. stamp, which previously gave a maximum of thirty full-stroke blows, the rate was increased by the addition of the accelerator to seventy blows per minute, and the productive capacity of the stamp was therefore more than doubled. The accelerator is made in several sizes to suit stamps of various falling weights.

Pneumatic Dispatch System in a Steelworks

WHERE a number of scattered points are to be brought into communication by means of a pneumatic dispatch system, it has hitherto been customary to connect each point with a central station by separate tubes, so that in a large modern shop, for example, the cashier's room is the terminal of many scores of tubes. Monsieur Lucien Krieger, of Paris, has devised and perfected a simplified apparatus by which a single tube system can serve a large number of stations. In this system each of the stations is fitted with an ejector device shown in Fig. 1, in which the energising of an electromagnet causes the finger A to set itself diagonally cross the path of the cartridges. The latter, on striking this finger, are diverted through a light hanging flap B. When the electromagnet is de-energised, the finger returns to the position shown by the dotted lines A′ and the cartridges will pass this particular station to be ejected at one of the others. Thus the operator at the central station, by pressing a button to correspond with the station to which it is desired to dispatch the cartridge automatically causes the latter to be ejected at this particular point in the system. The closing of the flap again by its own weight operates a mercury contact device—not shown on the drawing—which causes the magnetic circuit to be broken and the finger to return to the "clear" position. We are informed that in an installation at the Strasbourg post-office sixteen stations are served by a single tube system in this manner.

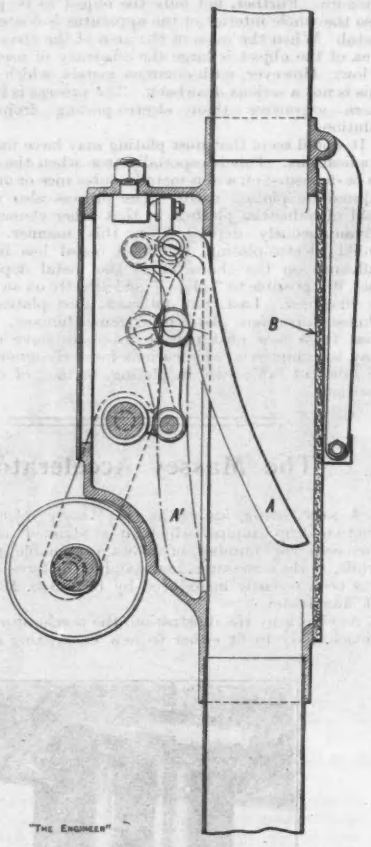


FIG. 1—EJECTOR DEVICE

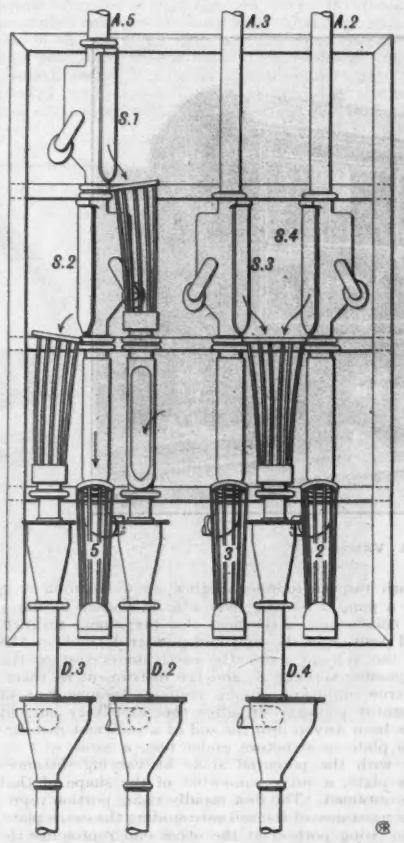


FIG. 2—ARRANGEMENT OF EJECTORS AND DISPATCH TUBES

An interesting adaptation of this dispatch system is also employed in an installation which has recently been completed by Monsieur Krieger at the steel works in Lorraine, Le Hauts Fourneaux de la Chiers, Longwy. In this case intercommunication between a number of points lying in different directions from the central station is effected automatically. Separate tube lines to each point of the system are necessitated by the lay-out, but selective ejectors are employed to take the place of an operator at the central station. This installation is designed for the transmission of samples from (*a*) the Bessemer furnaces and (*b*) the electric furnaces, to either the physical or chemical laboratory, and for the prompt return of the test results to the stations at the furnaces. Fig. 3 shows diagrammatically the lay-out of this interesting installation, and Fig. 4 is a view of station No. 1 in the physical testing laboratory. This is the central or junction station for intercommunication between the others. Stations Nos. 2 and 3 in Fig. 3 are the Bessemer and electric furnace positions respectively. Station 4 is situated on a floor below the chemical laboratory at a point where the samples are cut and marked and sample drillings taken. Station 5 is in the chemical laboratory. Station 2 is about 150ft. from station 1; station 3 is some 300ft. further; and station 4 is approximately 150ft. from station 1.

Special long steel cartridges are used to carry the hot bar samples, which weigh about 1½ lb. each. The furnace stations 2 and 3 do not need to communicate with one another, but only with stations 1 and 4, as all samples destined for the chemical laboratory must go to station 4 first, the latter dispatching only to the chemical laboratory overhead. Hence provision is made for the following lines of communication:—Station 1 receives from Nos. 2, 3, and 5, and dispatches to Nos. 2, 3, and 4; station 2 receives from Nos. 1 and 5, and dispatches to Nos. 1 and 4; station 3 receives from Nos. 1 and 5 and dispatches to Nos. 1 and 4; station 4 receives from Nos. 1, 2, and 3 and dispatches to station 5; station 5 receives from No. 4 and dispatches to Nos. 1, 2, and 3. To effect these operations automatically, a separate tube circuit runs from station 1 to each of the three stations to which it can dispatch, namely, Nos. 2, 3, and 4, and this last circuit includes also station 5.

Each of these tube systems is served by a small Roots blower, and each of the outlying stations is provided with an arrival and a dispatch fitting in the tube circuit. The arrival fitting comprises in each case a fixed finger set diagonally across the tube and a hanging flap somewhat similar to that shown in Fig. 1, except that no mechanism is provided for moving the finger. The receiving tubes at station 1 are each provided with a fixed ejector finger for the delivery of the cartridges at this station, and in addition each tube is fitted with one or two selective ejectors similar to that shown in Fig. 1, these being disposed so as to eject the cartridges into the mouthpieces of the dispatching tubes. In order to avoid condensation in the tubes which pass through considerable ranges of temperature, and some of which are laid underground, each tube system has a closed circuit, and the cartridges enter the dispatch tubes at Station 1 through a double flap valve which forms a seal. The other dispatch fittings are simply hanging doors or flaps, which are opened momentarily for the dispatch of a cartridge.

Fig. 2 shows the arrangement of the various ejectors and dispatch mouths at station 1, in which Nos. 2, 3, and 5 are the receiving baskets from their respective stations, with the fixed ejector doors immediately above them. Tubes marked A 2, A 3, and A 5 are the arrival tubes from stations similarly numbered, and tubes marked D 2, D 3, and D 4 are the corresponding dispatch tubes, each fitted with a pair of castings containing the sealing flap valves. Each of the dispatch tubes is terminated at its upper end by a basket-formed bell-mouth. S 1, S 2, S 3, and S 4 denote the selective ejectors, the first two of which serve to transfer the cartridges from tube A 5 to dispatch tubes D 2 and D 3 respectively, and the remaining two to transfer cartridges from lines A 3 and A 2 respectively to dispatch tube D 4.

Now suppose it is desired to transmit a cartridge from station 2 to station 4. At station 2 there are two push buttons labelled 1 and 4 respectively, and the operator first presses the button marked 4. If any section over which the cartridge has to travel is already engaged nothing will happen, but if the line is clear the following will take place:—(*a*) a light will show above the push button; (*b*) a bell will ring at station 4; (*c*) the blower operating the station 2 circuit will start; (*d*) the selective ejector S 4 will throw the movable finger across the tube. The cartridge is then placed in the tube at station 2 and is drawn along to station 1. On arrival at S 4 it passes through the hanging door and drops into the basket forming the mouth of dispatch tube D 4. As the hanging door of the selective ejector S 4 opens, a mercury contact attached to its hinged spindle operates a relay and stops blower No. 2 and a second mercury contact on the same spindle causes the blower for dispatch tube D 4 to start. At the same time the circuit which energises S 4 is broken, and the movable finger drops back into the "clear" position. Finally, the cartridge reaches station 4 and is ejected into the receiving basket. There it strikes a contact which stops the ringing of the bell, causes the blower to stop and extinguishes the light above button 4 at station 2, and thus the whole system is cleared for further transmission.

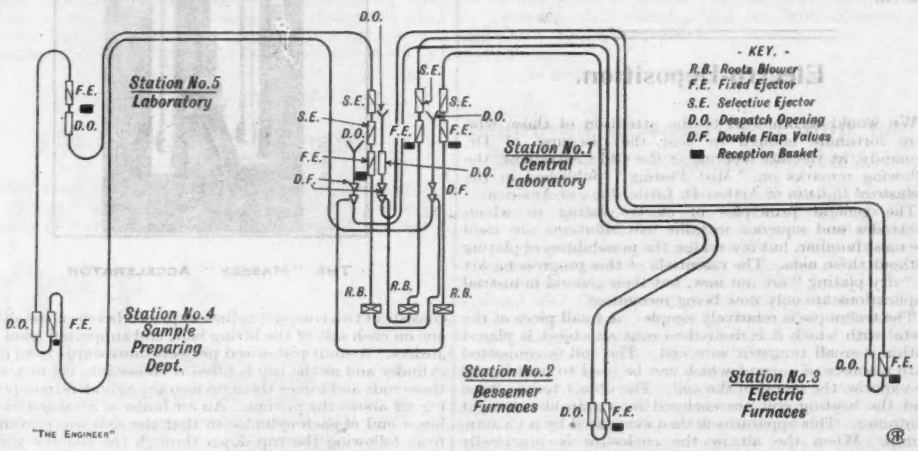


FIG. 3—LAY-OUT OF PNEUMATIC DISPATCH TUBE INSTALLATION

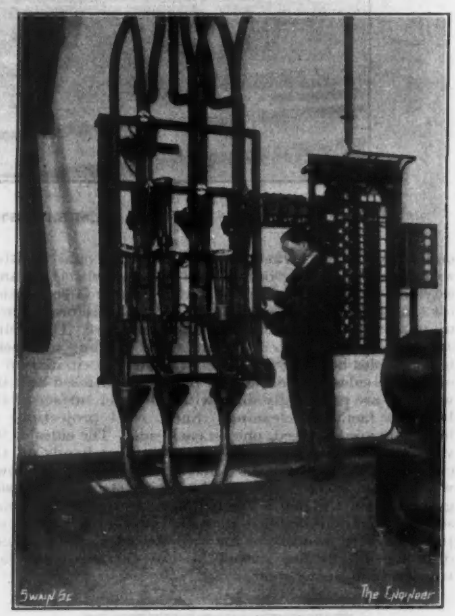


FIG. 4—VIEW OF STATION IN PHYSICAL LABORATORY

As the circuits are all one-way, there is no possibility of collision between the cartridges, and should a cartridge be accidentally inserted into a tube before the "clear" signal is received, the blowers are of ample power to propel two cartridges along the same tube. Each blower is coupled direct to a 3 horse-power motor. The starting and stopping of the motors so that the blowers are only in operation when a cartridge is actually required to be dispatched is a refinement which results in economy of power when the number of transmissions is small. When a frequent service is required this refinement is not necessary, and in such a case a single blower will serve a number of tube circuits.

The substitution of a pneumatic tube system for messengers at the Longwy steel works has resulted in a marked economy, as the blooms can be passed to the rolling mills much more quickly after pouring, and thus much reheating is avoided.

The Krieger patent rights in this country, both for pneumatic dispatch tubes and for selective conveyors of all kinds, are held by Elca Conveyors, Limited, 16, Victoria-street, London, S.W.1, and the appliances are manufactured under licence by Henry Simon, Ltd., Cheadle Heath, Stockport.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Conditions Unaltered.

IN the engineering, the iron and steel, and the heavy manufacturing industries in the Midlands and Staffordshire the general trade position is substantially unchanged on the week. Steady, but slow, progress is being made and the market tone is maintained, though there is but small recompense in the shape of orders, for the confidence displayed alike by producers and consumers of iron and steel. There was a good attendance on 'Change in Birmingham this week and interest was displayed in even the slightest sign of advancement. A number of manufacturers spoke hopefully of their future material requirements, and there seems to be grounds for hope that production of iron and steel will gradually increase. There are no indications as yet, however, of the probability of bringing additional plant into commission. Output from the existing furnaces and mills is capable of considerable improvement, and it will be some time before consumptive demand, if it does not advance more rapidly than it has done so far this year, overtakes the productive capacity now available. The improvement in engineering in Staffordshire is slow, but greater progress is being made in the lighter branches. In the heavy section orders are scarce and inquiries are not numerous. Constructional engineers report that business is very slack. The demand for iron and steel is chiefly for immediate requirements, but these are, fortunately, in advance of what they were a month ago, and hopes are expressed that the end of February will show even further betterment of the trade situation.

Iron and Steel.

In none of the iron and steel branches of the market in the Midlands has there been any price alteration during the past week. The Central Pig Iron Producers' Association having re-affirmed selling rates for the Midland zone, there was little to interest consumers of Derbyshire and Northamptonshire iron this week. Their requirements were about on a par with those of recent weeks. In the finished iron trade indications of any re-energising of the market were lacking, and ironmasters adhered to recent quotations. Finished steel sells slowly at the prices fixed by the Association, while in the steel semis department producers maintain late selling rates. Re-rollers are not quite so busy as they were a couple of weeks ago, but as Continental competitors are still more or less off the market pending cartel developments, a renewal of buying of native half-products is looked for. The market for galvanised sheets is quiet and values are unaltered alike for home and export business.

Bilston Firm's New Steel Plant.

A new re-heating furnace which, it is anticipated, will result in increased production will shortly be brought into service at the Spring Vale Steel Works, Bilston, of the Alfred Hickman branch of Stewarts and Lloyds, Ltd. Messrs. Stewarts and Lloyds have in course of the past few years remodelled and modernised their Bilston works. The works are intended primarily to supply the varying qualities of steel which are necessary for the different processes of tube making. The company is continuing this policy, and at the present time the plant is one of the most fully occupied steel plants in the country. The new re-heating furnace is intended to serve the mills used in producing bars for seamless steel tubing. It has been designed by the works staff in collaboration with the company's central research and technical departments. It is expected to go into production early in March, and when in operation it will augment the already considerable capacity of the Bilston mills as far as bars for tube steel are concerned.

Wolverhampton Foundry to Re-open.

It is announced that British Enamels, of Howard-street, Wolverhampton, have taken over the works of the Patent Axlebox and Foundry Company, Wednesfield. Preparations are in hand for reviving at the foundries the manufacture of axle-boxes formerly carried on in the district. It is hoped within the next few months that about 100 hands will be employed.

Institution of Structural Engineers.

The Midland Counties Branch of the Institution of Structural Engineers held its seventh annual dinner and ladies' evening at the Midland Hotel, Birmingham, on Saturday last. Mr. H. Ferrington presided over a gathering representative of many branches of engineering. "The Institution" was toasted by Mr. Herbert H. Humphries (Birmingham City Surveyor and Engineer), who enumerated a long list of bodies which had acknowledged its sphere of usefulness. The progress had been steady and sure, and their members were represented on various important bodies. With regard to the future, the outlook seemed more hopeful, and he was sure they would benefit accordingly. Acknowledging the toast, Major E. C. P. Monson (the national President) agreed that the Institution had made great strides in the few years it had been in existence. Regarding membership, he could assure them they had been admitting only the right type of men. Now they were looking forward to the receipt of a charter. Most of the big societies were chartered bodies, and that was what they hoped to be. He trusted that either this or next year such an ideal would reach fruition.

British Foundrymen's Dinner.

The Birmingham, Coventry and West Midlands Branch of the Institute of British Foundrymen held its annual dinner on Saturday last at the Imperial Hotel, Birmingham. Mr. J. G. Pearce presided over a large company. In toasting "The Institute of British Foundrymen," Colonel J. Baldwin Webb said that Shropshire, one of the divisions of which he represented in the House of Commons, was particularly interested in the foundry industry because it was the native county of two of their greatest personalities—Darby, who, in 1709, was the first man to adopt the smelting of iron on a large scale by means of coal and coke; and John Wilkinson, who was generally regarded as the "father of the iron trade." Responding to the toast, Mr. Victor Stobie (President of the Institute) said that Birmingham was the birthplace of the Institute, which had grown into a national organisation. The Institute was not only composed of practical men, as was sometimes thought, but also had within its membership scientists of world renown, men who regularly contributed papers of great value and were a guide for the industry.

Birmingham and Electricity.

A record output of 13,000,000 units of electricity in one week has just been recorded in Birmingham. Consumption of current steadily increases and new consumers are being coupled up at the rate of upwards of 1000 a month. During the quarter ended December 3169 additional premises were furnished with supplies for the first time, representing a connected load of upwards of 27,000 lamps and 7000 H.P. in motors, radiators, &c. The sales of electrical energy during the quarter showed an increase of 10·4 per cent. compared with the same period of 1931. Taking the nine months of the financial year to date, the rate of increase in sales amounted to 12½ per cent. It is of interest to note that this compares with a figure of 7·1 per cent. in the quantity generated for the country as a whole during 1932.

Birmingham Presentation.

On Wednesday of this week the workpeople and staff of the General Electric Company's engineering works at Witton, Birmingham, made a presentation to Mr. W. H. Heaton in recognition of his twenty-one years' service as works manager. Mr. Heaton was trained for marine engineering and in 1903 was awarded the Board of Trade extra first-class engineers' certificate. In the same year he was appointed assistant superintendent of the British Westinghouse Company, Manchester. In 1905 he was elected a member of both the Institution of Electrical Engineers and the Institution of Mechanical Engineers. In 1912 he was appointed to his present position. He has the satisfaction of knowing that the present output of the works is ten to twelve times greater than it was at the time of his appointment. Mr. Heaton is a member of the General Council of the Engineering and National Employers' Federation, and of numerous other engineering bodies.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Export of Second-hand Machinery.

THE vexed question of the export of second-hand industrial machinery, more especially of textile plant, is again becoming prominent. With the closing down of redundant cotton mills during recent years, much of the equipment, often in first-class working condition, has been bought at bargain prices and shipped to foreign countries. Not only has this reacted to the detriment of the Lancashire cotton industry, but it has also been one of the factors to contribute to the depression in the textile machinery industry in the county. There is now evidence that a more determined stand is being made against plant from Lancashire mills finding its way abroad. At a sale of mill machinery in Lancashire during the past few days, buyers for foreign mills were barred, and sales were confined to local interests. The Lancashire Cotton Corporation, which still owns many mills that are surplus to current or prospective needs, is also considering measures to prevent machinery bargains of this nature going abroad.

The Liverpool-Manchester Road.

The Highways Committee of the Lancashire County Council reports that the work of the contractors on the Liverpool–Manchester road is approaching completion, and that certificates have been granted for lengths totalling 19½ miles, including one continuous length between Haydock and Irlams-o'-th'-Height, which has been opened for traffic. The remaining 5½ miles of the road will, it is anticipated, be ready for certifying by about the end of March, in which case the whole of the 25 miles of road will have been completed about twelve months in advance of the contract time. The Highways Committee is awaiting a reply from the Ministry of Transport to a request for permission to complete the road with an asphalt surface as originally planned, on the grounds of the lower cost of asphalt work now prevailing, the advantage in the execution of the work before the road is opened to traffic throughout, and the necessity of avoiding the percolation of water through the joints of the concrete.

More Oil-driven Omnibuses.

It has been decided by the Transport Committee of the Manchester Corporation to place contracts for the construction of chassis for thirty new oil-driven motor omnibuses and also for the construction of the bodywork for a number of these omnibuses. Contracts for twenty-five chassis, ten bodies, and five body shells are, it is proposed, to be placed with Crossley Motors, Ltd., Manchester, for five chassis and five bodies with Leyland Motors, Ltd., Leyland, near Preston, and for five bodies with the Metropolitan-Cammell Weyman Company, London. The shell bodies, to be made entirely of metal, are to be assembled at the Hyde-road Works of the Manchester Transport Department. Recent experiments with an all-metal omnibus are regarded as extremely satisfactory.

Non-ferrous Metals.

Except in the case of spelter, which continues the declining tendency that has characterised the metal during the past month or so, the non-ferrous metal markets during the past week have been steady to firm with, in the case of tin, a rather substantial rise on balance that has served to wipe out the whole of the losses sustained since about the beginning of the year. The aggregate business done in the copper section has not been extensive, but the undertone in standard brands of the metal has been somewhat steadier, with refined descriptions slightly lower compared with a week ago. The demand for tin has shown no marked improvement, but sellers have been less disposed to press supplies on the market, and the feeling has, in consequence, been distinctly firmer than at any time during the past four or five weeks, with quotations about £2 15s. per ton dearer on the week. A quiet business has been transacted in the lead section, and values have been well held, allowing for minor fluctuations during the week, at about the levels that have been current since the middle of January. Compared with a week ago, spelter prices are between 7s. 6d. and 10s. per ton cheaper, thus continuing the persistent fall that has been in evidence for some time. At the moment of writing, however, the undertone seems to be rather less uncertain, and it is not unlikely that a favourable reaction will be experienced during the coming week. In the meantime, the demand for spelter is only on a relatively small scale.

Iron and Steel.

Somewhat mixed conditions are reported on the iron and steel markets here this week. Foundry iron sales generally are on an early delivery basis still, and whilst some makers state that deliveries in the aggregate to consumers in the Lancashire district have shown a slight falling off, the experience of other firms is that they have been maintained. It is safe to say, however, that there has been no material expansion of the call for iron. In some branches of the using trades, that concerned with light castings is one of the few requirements which are maintained on a relatively satisfactory scale, but in textile machinery making and in the jobbing foundries the demand is poor. Prices are steady, however, with Derbyshire, Staffordshire, and Cleveland No. 3 all quoted at 67s. per ton, Northants at 65s. 6d., Derbyshire forge iron at 62s., Scottish foundry at about 82s., and West Coast hematite at 80s. 6d., all for delivery to users in the Manchester district. There is a comparatively good demand about for certain classes of special steels, including bright drawing, free cutting, and alloy steels, but the call for heavy materials generally remains disappointing, although there is hope of a seasonal improvement in constructional engineering. Inquiry for boiler and locomotive plates is small, and in most instances relates to repair work. Acid and basic boiler plates are quoted at about £8 10s. per ton, with small re-rolled bars at £6 15s., sections at £8 7s. 6d., joists at £8 15s., tank plates at £8 17s. 6d., and large diameter bars at £9 7s. 6d.

BARROW-IN-FURNESS.

Hematite.

The hematite pig iron trade continues on the same level and, fortunately, the steel departments are still working, and this fact accounts for a considerable proportion of the local output. Trade on home account is maintained, but there is little business with the Continent or America. It is not expected that there will be much immediate change in the market, and one of the first signs will be a stiffening of prices, which, at present, allow little, if any, margin. Stocks are coming down slightly at some of the works. The iron ore trade is, on the whole, quiet, and the outside demand for native sorts is still on the thin side. Foreign ore is in restricted demand. The steel market is not very lively, but Barrow has contracts for rails which keep the mills engaged, but fresh orders would be very welcome. The hoop mills are kept going and are, no doubt, benefiting by the effect on prices of the present value of the pound. The special mills at Barrow are engaged on certain steel products, including many items which are used in the manufacture of motor cars, such as steel buffers. Shipping is very quiet, and there is little arriving or leaving the port at present. Fuel is in moderate demand.

SHEFFIELD.

(From our own Correspondent.)

Position Less Satisfactory.

THE month of January closed with trade generally in a less healthy position than that of a few weeks previously. The heavy branches, which have been far from active for some time, report that since the beginning of this year work has shrunk rather than expanded. The problem of finding an outlet for the production of the open-hearth furnaces is as acute as ever. Not only is there no development in ordering for forward delivery, but important inquiries are very scarce. The sections concerned with the production of motor car requisites are suffering from the effects of the Salter report. The proposals of that report, for heavily increasing the taxation of motor transport vehicles, caused such alarm among users that orders for new omnibuses, lorries, and drays fell off greatly, and this fact had a serious reaction upon Sheffield firms supplying springs, steel castings, forgings, tool steel and tools. As the Government took no action on the report, the alarm was beginning to abate, but it has been revived by the controversy on railwaymen's wages, and the fact that supporters of railway interests are pressing the Government to legislate on the lines of the report. Sheffield is losing a large amount of trade, owing to the uncertainty of the position.

Shipbuilding Prospects.

The trade in marine forgings and other shipbuilding requirements has been very quiet for a long time, but there is hope for improvement in a statement published last week as to the placing of orders for new tonnage. The Shipbuilding Employers' Federation states that it is extremely probable that the figures for new tonnage

begun in British shipyards during the March quarter will exceed the tonnage commenced during the whole of 1932. A representative of the Federation adds that the efforts of the shipbuilders to attract new orders are being supported by the British steel makers, with whom, since 1931, they have established closer co-operative arrangements, which enable shipbuilders to obtain their principal raw material on terms which permit them to supply ships to British or foreign clients at tempting prices.

Magnets and Tools.

There is quietness in certain special lines which had a brisk run during the latter half of last year. Among these are permanent magnets for loud speakers. So great was the demand for these articles for several months before Christmas that local makers found a difficulty in coping with it, but now most of them report a shortage of orders. The tool trade, while good in some sections, is not as busy as it was in December. The only exceptions to the general lull in trade are lines in which the city has a comparative monopoly. It is thought, however, that the setback is probably only temporary, as January is usually a quiet month. The falling-off is confined mainly to the home market, and it is gratifying to know that, on the other hand, there are signs of steady expansion in overseas trade. Stocks of Sheffield products abroad have been allowed to shrink to the point of exhaustion, and consumers now appear to be replenishing them.

Chromium Plating.

One of the most flourishing branches of local trade at present is also one of the newest, that of chromium plating. There is an increasing call for chromium-plated articles of great variety. There are now in Sheffield three or four of these plating plants, operated privately by manufacturers, and ten or a dozen "trade" plants, four of which were started, or made ready for starting, during the last two months. Owing to severe competition, prices of finished articles have fallen rapidly, but it is now reported that, owing to successive improvements in technique it is possible to maintain a sufficient standard of profits to warrant the extension of existing plants and the installation of additions. At one time Birmingham led in this industry, but Sheffield platers now claim that they have definitely challenged the supremacy of the Midland city.

Hollow-forged Drums.

The production of hollow-forged drums, to withstand high pressures, continues to be one of the most active branches on the heavy side of Sheffield's steel industry. One of the latest examples of this class of work to be announced is the forging and finish-machining, at the Vickers works of the English Steel Corporation, of three sets of boiler drums, for the Dartford Paper Mills, to the order of International Combustion, Ltd. Particulars published with regard to one set, consisting of three drums, state that two of them are 19ft. 6in. long by 4ft. inside diameter, and weigh about 11 tons each; while the third is 16ft. 3in. long by 4ft. inside diameter, and weighs about 9½ tons. In all, 1131 holes were machined in these three drums to take the tubes. These drums are, of course, only of comparatively small dimensions, as similar drums for big electric power stations run up to much larger sizes.

A Giant Shovel.

It is learned that Ransomes and Rapier, Ltd., have just received an order to build an excavating shovel claimed to be the largest ever made or used in Europe. It will be constructed throughout at the firm's Ipswich works, and wholly of British material, and is being supplied to Stewarts and Lloyds, Ltd., who intend to employ it in uncovering their ironstone field at Corby, Northamptonshire, where works are being erected to produce steel by the basic Bessemer process. The shovel will have a bucket capacity of 9 cubic yards, a dumping height of 68ft., and a dumping radius of 101ft. It will weigh about 500 tons.

Works Plant to be Dismantled.

It is announced that the plant of the Penistone Steel Works is to be dismantled. The works, which were formerly the property of Cammell, Laird and Co., Ltd., were closed a few years ago under the rationalisation scheme which followed the amalgamation of that company with Vickers, Ltd., in the English Steel Corporation. Contracts for the immediate dismantling of the plant have been made with Thos. W. Ward, Ltd., of Sheffield. The huge building, covering 110,000 square feet, which housed one of the finest tire mills in the world, is to be left standing for adaptation as a modern factory. The works cover about 27 acres.

A Kuehnrich Business for Sale.

It is announced that the cutlery manufacturing business of the Universal Rustless Steel Corporation, Ltd., Crysteel Works, Coleridge-road, Sheffield, is for sale. This recalls one of the latest ventures of the late Mr. P. R. Kuehnrich, who held a prominent position in the steel world, and who died a few months ago. The company was formed to manufacture a new steel named Crysteel, invented by Mr. Kuehnrich, who predicted that within eighteen months 6000 people would be working on Crysteel products, and regarded the invention as one of world-wide importance. Offers are being invited for the whole of the business, including patents and trade marks, Crysteel raw material in the form of ingots, billets, bars, slabs, sheets, and strip, stock of finished and semi-finished cutlery, forks, and spoons, fixed plant and loose tools, office and warehouse furniture, &c.

Bridging the Humber.

The amended scheme for bridging the river Humber by the adoption of a suspension type of bridge and a readjustment of the finances, has advanced a stage further, the Hull City Council having approved of the proposals by 34 votes to 26. The maximum cost is estimated at £1,500,000, against £1,900,000. The number of pillars in the river is to be reduced from fifteen to seven, and the spans are to be 900ft. wide. The new proposals have been forwarded to the Humber Conservancy Board, and are being submitted to that body's engineering experts. When their report is received, it is proposed to have a meeting of the Parliamentary Committee of the Board with representatives of the Corporation, and perhaps with other interests.

Yorkshire Land Drainage.

The River Ouse (Yorkshire) Catchment Board has approved of a large programme of work of land drainage and other improvements, which will provide employment for nearly 800 men for five years, and which can be put in hand if assistance in the way of grants is forthcoming from the Government. The schedule includes the following items:—Raising and strengthening of banks, £55,000; dredging and widening, £61,000; removal and enlargement of weirs, £37,000; diversions and cuts, £173,000; work in internal drainage districts, £95,000; other works (rivers Upper Don, Dearne, and Rother), £375,000. The scheme will be submitted to the Trent Catchment Board with a view to its presentation to the Government with an appeal for grants. The schedule does not include any work on the lower reaches of the Don, which are outside the jurisdiction of the Board, but it is stated that the scheme for the improvement of that part of the river would cost £250,000, and would increase the total number of men to be employed to about 960.

NORTH OF ENGLAND.

(From our own Correspondent.)

Prospects Brightening.

PROSPECTS in the North of England iron and steel industry have brightened up considerably during the past few days, and there seems to be real evidence of improvement. In some cases output is being increased, and orders which are announced this week will ensure even brisker working conditions. Teesside firms have come out fairly well in the allocation of orders for steel chairs from the Southern Railway Company. An order for about 2000 tons has been placed with the Teesside Bridge and Engineering Works, and will help to keep the present staff employed. The Tees Ironworks of Pease and Partners, Ltd., have also received an order for 5000 tons of these chairs. This will mean about five months' work, although, as in the case of the Teesside Bridge Company's order, the new contract will make no difference to the employment needs of either works. The prosperity of the iron and steel industry in this district depends to a large extent upon the condition of the shipbuilding industry, and it is encouraging to note some definite move in the placing of orders for new vessels. Orders for three cargo vessels of fair tonnage are destined for the Tees yards. I am informed on good authority that the contracts are likely to be placed with the Furness Shipbuilding Company, Ltd., Haverton Hill, shortly. The orders will mean work for nine months. Negotiations are still proceeding, but it is confidently expected that the orders will be placed. John Readhead and Sons, South Shields, are shortly to commence the construction at their yard of an 8000-ton vessel, and the work will employ a large number of men for several months. Messrs. Readhead have entered into an arrangement on a joint account with a well-known firm of London shipowners, and although the contract has not been definitely signed, only the usual formalities remain to be completed, and these are to be settled in the next few days. Messrs. Readhead have not built a ship since December, 1930.

Pig Iron Prices.

Official details are now available regarding the agreement between the Cleveland and Midland ironmasters which, without wholly eliminating the healthy influences of competition, will put an end to the more glaring anomalies of price-cutting and selling below cost. The effect of the agreement is that Midlands and Cleveland ironmasters will quote approximately on an equal basis for iron of equal quality, and in all cases delivered prices will be quoted to home consumers. The country has been divided into a series of zones. Thus, in the Cleveland area, which embraces Middlesbrough, Stockton, Thornaby, and South Bank, the delivered price of No. 3 G.M.B. Cleveland pig iron will henceforth be 62s. 6d. Estimating cost of delivery at 2s., this new price represents an advance of 2s. per ton. No. 1 foundry and siliceous iron will be charged at a premium of 2s. 6d., and there will be a uniform rebate of 1s. per ton on No. 4 foundry and No. 4 forge. The rest of England from the Scottish border to the Midlands zoned area is divided by a straight line running due north and south 50 miles west of Middlesbrough. To the east of this line the delivered price of No. 3 Cleveland iron will be 64s. 6d., and to the west of that line the delivered price will be 69s. Further fixed prices will apply to Scotland, but an old-standing grievance of local consumers, who complained that Scottish buyers have been getting Cleveland iron at a preferential rate, is largely removed. Henceforth, the delivered price of Cleveland iron in Scotland will be increased to approximately the same level as the local price, and there will be no underselling by Midlands makers. The makers claim that the new prices will, for the first time for many years, leave a small margin of profit, and in the careful zoning there is evidence of a desire to mete out equal justice to all home consumers. On the new price scales there are now hopes of better business, and an early expansion is looked for.

Hematite Pig Iron.

In the East Coast hematite pig iron trade sales are expanding on an encouraging scale. Some useful contracts have been fixed with consumers in South Wales, and deliveries are likely to increase. In other directions consumers are attracted by the low prices, and they are now purchasing fair quantities at or near 59s. for East Coast mixed numbers, and 59s. 6d. for No. 1 quality.

Ironmaking Materials.

Market transactions in foreign ore are still very quiet, and best Rubio is nominal at 15s. 3d. c.i.f. Tees. Sales of blast-furnace coke are not easily arranged, and for average qualities producers ask 16s. delivered at the works.

Manufactured Iron and Steel.

There is a much better tone in the manufactured iron and steel trade. The contracts for steel chairs mentioned above are a welcome development, and still greater hopes are centred in the prospect of more new vessels being built at North-East Coast yards. In the semi-finished steel section producers have better order books than for a considerable time, the import duties having shut out Continental competition. Iron and steel scrap prices are very firm. Scarcity of heavy steel is rather acute, and the supply of cast iron and machinery metal is not equal to requirements. Recent transactions have been heavy, both for home use and for shipment overseas, and demand continues good.

The Coal Trade.

In the first month of the new quarter the quotas of production in Northumberland and Durham were not reached, but February may accelerate the need for increased allowances. The position in Northumberland is much stronger than in Durham, as steam coals in the former county are in strong demand, whereas all Durham coals are not enjoying equal briskness. Durham steams and best qualities of bunker and gas coals are doing very well indeed, but there is not the same activity in second-grade gas and bunkers, and coking coals have dropped to a quiet trade once more. The county has so many kinds of fuel to dispose of that they are rarely all in keen request. The pits, however, are working much more regularly than they were a few months ago, and on the whole the Durham outlook inspires hope for an animated run of trade to the spring. New business is difficult to place for any class of Northumberland steam coals for shipment within the next three weeks. There is a good inquiry circulating, and quotations hold firmly. Orders placed are substantial for this month, and for any additional supplies recent values are obtainable ranging from 14s. to 14s. 6d., according to actual delivery dates. Prime Wear steam also are quoted firmly and rather difficult to obtain at 16s. Tyne primes are almost sold out, 13s. 6d. being the minimum price indicated. Northumberland best smalls are nominal at 8s. 6d., and Tyne prime smalls at 9s., prospective output being already well earmarked. There is increasing pressure for Durham gas coal, and best qualities are only offered in moderate volume at 14s. 6d., with special Wear qualities at 15s. The secondary gas position is steadily improving, and 13s. 3d. to 13s. 6d. is firmly asked. Favourite bunker brands command 14s. 6d. to 14s. 9d., and good ordinary are at steadier values of 13s. 3d. to 13s. 6d. Coking unscreened coals are offered freely at 12s. 6d. to 13s. 3d. Shipments of coke are heavier than of late, and the undertone is brighter. Patent oven coke orders have been secured more freely, and up to the middle of February prices rule steady at 15s. to 15s. 6d., with superior class at 16s. Coke nuts are steady at 16s. 6d. to 17s. 6d. Best gas coke continues firm at 18s. 6d., and vertical are steady at 22s. 6d.

SCOTLAND.

(From our own Correspondent.)

Shipbuilding.

CONDITIONS in the shipbuilding industry continue to show some improvement. During the past two to three months the flow of orders has been greater than that experienced for nearly three years, and there seems to be every prospect of the improvement continuing. Last week Lithgows, Ltd., of Port-Glasgow, received an order for a 2000-ton cargo steamer for Liverpool owners, and this was the sixth order booked by Clyde shipbuilders since the New Year holidays. There are now twenty-five vessels of an aggregate tonnage of 45,000 tons in the course of construction on the Clyde. Reports also indicate a fair inquiry. A sustained improvement in the shipbuilding industry would be of immense benefit to the steel, iron, and allied trade in the West of Scotland.

Steel.

Business in the Scottish steel trade still runs on quiet lines, but makers anticipate that before long specifications in connection with the recent shipbuilding orders will be circulated. Movement of this nature will be extremely welcome, as orders for shipbuilding material have been exceptionally scarce for a considerable period. There has been some sign recently of a broadening out in the demand for structural material for the home market, and the export market anticipates inquiries from Canada and China.

Steel Sheets.

The improvement in the turnover in black sheets is maintained. Good quantities have been bought for Japan. The bulk of the business is in light gauges and there is still plenty of room for improvement in the heavy gauges. Galvanised sheets are rather quiet.

Tubes.

Tube makers are not particularly busy, but inquiries are still being received on a considerable scale and prospects appear brighter.

Iron.

So far as bar iron is concerned the tonnages rolled are still rather insignificant in practically all grades, and the same may be said of re-rolled steel bars. The former are unchanged in price and the latter still quoted £7 5s. home and £6 10s. per ton export.

Pig Iron.

Business in pig iron still fails to show any tendency to increase and the production is confined to the output of two furnaces. Shipments from Glasgow last week amounted to 388 tons (375 tons foreign), compared with 169 tons (50 tons foreign) in the same week last year. Last week a consignment of 800 tons of pig iron arrived in this district from Millom and Workington.

Scrap.

There has been a little more movement in scrap and prices are still round about 37s. 6d. for heavy steel and 47s. 6d. per ton for cast iron machinery.

Coal.

The Scottish coal market is firm in all branches. In all districts screened fuels are well taken up, and prices continue firm. In some cases the collieries are booked over two weeks ahead. Washed nuts have been inclined to ease during the past week or two, but sellers are now inclined to hold out for full prices. The result of the Irish election has caused disappointment in the West of Scotland, as there now seems little hope of a reversal of policy as regards tariffs against British goods, including coal. Accordingly, the traffic between the West of Scotland and the Free State is likely to continue on a greatly reduced basis. Aggregate shipments from Scottish ports last week amounted to 232,666 tons, against 255,709 tons in the preceding week and 256,039 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

The Coal Trade.

THE conditions so far as the steam coal section is concerned have been very quiet during the past week or so. It was thought that the cold spell would have brought fresh orders from the Continent for prompt cargoes, more especially as the transport of Polish and German coals was being interfered with by the ice, but, except that a few orders already held were brought forward for loading, nothing has occurred to infuse life into the steam coal trade. Now that the weather is milder, it is improbable that business from the Continent will be speeded up; certainly the market displays no indication of reviving at the moment, which rather shows that stocks held abroad are very considerable. Judging from the tonnage position at the docks, collieries should have been moderately well off of late, but the figures have been somewhat misleading for the reason that loading operations all last week were slowed up by the frost. Washed and sized coals were frozen in their wagons and washeries were similarly affected, with the consequence that supplies were not forthcoming at their usual rate, and as most cargoes now being loaded consist in part of washed or sized coals, shipment operations were retarded and some vessels, which in the ordinary way should have loaded and sailed last week, were kept over the week-end and were on demurrage. The effect of the severe weather is, as a matter of fact, reflected in the G.W.R. Company's returns of shipments of coal and coke last week. The quantity came to only 354,215 tons, as compared with 402,103 tons for the corresponding period of last year, while last week's total was 53,710 tons less than in the preceding week. This week opened with the tonnage position fairly good. The number of idle tipping appliances at the ports between Newport and Port Talbot was twenty-three, which was ten less than at the end of last week, but as outward chartering of late has been on the quiet side, it cannot be said that the outlook is very satisfactory for the steam coal side of the industry. In contrast, the anthracite section is active, and at Swansea this week started with all berths occupied and six steamers waiting to load. Business is practically featureless so far as prompt cargoes of steam coals are concerned. The Palestine Railways and the Jamaica National Railway are in the market for single cargoes of locomotive coals, while in regard to contract business it is now definite that the Andaluces Railway of Spain has contracted for 21,000 tons of locomotive coals for delivery at various Spanish ports between February and September next, the local firm to secure the order being Gueret, Llewellyn and Merrett, Ltd.

G.W.R. £1,000,000 Scheme.

Details of an important scheme for expediting the introduction of 20-ton wagons was received by South Wales colliery undertakings last week-end from the Great Western Railway Company in a letter signed by the general manager, Sir James Milne. This scheme, which is somewhat novel, has already had a favourable reception from leading men in the coal trade, as it is recognised that it will mean increased employment in this area and greater economy in transport, which is all to the good of the coal trade. The proposal of the G.W.R. Company is to have constructed 5000 20-ton wagons to be let out on hire to approved colliery undertakings for a period of ten years, with an option to purchase at a nominal figure at the termination of that period. It is a condition that the colliery companies to whom wagons are hired shall break up obsolete wagons of a total tonnage capacity of not less than that of the new 20-ton wagons. The G.W.R. Company is inviting from outside firms tenders for the construction of the wagons to the latest Railway Clearing House specification, and the wagons must be completed within twelve months. The success of the G.W.R. scheme depends entirely upon the response of the colliery undertakings, and it will be interesting to see what it will be. It must be recognised that the matter will require the greatest consideration, and while the consumption of coal, iron and steel entailed in the construction of the wagons means a great thing from the point of view of providing employment, those who are in the coal trade are only too well aware that the smaller wagons of 8, 10, and 12 tons have their uses, especially in the inland trade. At the same time it should not be a difficult matter for 5000 wagons of 20-ton capacity to be absorbed in the industry. The G.W.R. Company states that the average cost of the proposed new wagons will be about £220. Traders in this area have already had experience of the 20-ton wagon, as a number of them have been hired out for some years past. The G.W.R. Company itself bore the cost of 1000 of them, and by the end of this year there will be eighty-one appliances at the South Wales ports capable of tipping coal from the 20-ton wagons. With the greater use of the 20-ton wagon, collieries will have to re-adapt many screening plants and weighbridges, which at present are only suitable for dealing with 10 and 12-ton wagons.

Traffic at South Wales Ports.

Returns of traffic at the six leading ports in this area for the first fortnight of this year show that imports came to 131,117 tons, and exports to 904,609 tons, making an aggregate of 1,035,726 tons, which compares with 1,075,255 tons for the corresponding period of last year. It is very noticeable that on the import side supplies of iron and steel came to only 11,314 tons, as compared with 35,888 tons for the first fortnight of 1932. On the other hand, imports of oil amounted to 40,310 tons, as against 663 tons during the first two weeks of last year.

Miscellaneous Items.

Agreement has now been reached between the Amalgamated Engineers' Union and the dry dock employers in this area with respect to the new working arrangements to apply in this Channel. As a result, the revised terms affecting all sections of labour will come into operation as from the beginning of March. Work is to be resumed at the Cwmaman Pit, Aberdare, which has been idle for about six months. About 100 men are to be given employment, and will be engaged mainly in repair work and keeping the ventilation of the pit in order until the colliery resumes normal working. The notices which were served recently on the men employed at the Bargoed Colliery in the Rhymney Valley may not take effect. The men are now working on day-to-day contracts. The last two of four new dock gates have been placed in position at the Roath Dock, Cardiff. The contract for them was placed by the G.W.R. Company with Vickers-Armstrongs, Ltd., of Barrow, about three years ago, the cost being approximately £30,000. Each gate weighs about 200 tons, and had first to be erected at the maker's works, then taken to pieces, transported to the dockside at Cardiff, and there reconstructed.

Current Business.

The steam coal market continues almost unchanged, the day-to-day activity being negligible. Large coals of most descriptions are freely offered, as standing stocks are excessive, but washed coals and sized qualities are very scarce and remain firm at a premium. Coke moves off steadily, and patent fuel is fairly well stemmed, but pitwood is quiet in demand and prices are weak at about 19s. 6d. to 20s. 6d.

BRITISH STANDARDS INSTITUTION.

All British Standard Specifications can be obtained from the Publications Department of the Institution at 28, Victoria-street, London, S.W.1. The price of each specification is 2s. 2d. post free, unless otherwise stated.

ANNEALED COPPER WIRE.

No. 156—1932. Since the issue in 1922 of the first edition of the British Standard specification for enamelled, high-conductivity copper wire, considerable improvement has been made in the manufacture of this material, with a corresponding improvement in the quality of the product. This development has been greatly assisted by the investigations carried out by the Electrical Research Association, and the results of these investigations have enabled a revision of the B.S. specification to be made. It has, for instance, been found possible to make the requirements regarding freedom from pinholes much more stringent than in the old specification. In addition, the maximum permissible overall diameters of the enamelled wires have been slightly reduced, without any reduction in the severity of the high-voltage test. No minimum overall diameter is specified, since, from the users' point of view, the thinner the enamel the better, provided the wire passes the electrical tests.

All the tests given in the original specification have been retained, and a clause covering joints has been added. The methods now adopted of carrying out the mechanical tests simulate more closely practical conditions, and although the diameters of the mandrels on which the wires are wound are greater, the present test is more satisfactory than the old test. It has not been found practicable to dispense with the "rough and ready" thumbnail test which is found so useful by an experienced person. An improved form of test for inflammability of enamel has been substituted for the original test.

The nominal sizes of copper wire adopted conform with those in B.S.S. No. 128, the enamelled wire specification covering the primary and secondary sizes in that specification from 0·002in. up to 0·128in. diameter. In view of the liability of the wire to become stretched slightly during the process of enamelling, it is necessary to allow greater tolerance on resistance of enamelled wire than on plain copper wire. This aspect of the problem has been considered in the course of the revision of B.S.S. No. 156, and a more rational series of tolerances on resistance has been adopted in the present specification, the values of tolerance now adopted for the sizes of wire from 0·01 up to 0·048 (the maximum size in the old specification) being appreciably less. The method of expressing the tolerance is more convenient in the revised specification.

CONCRETE PLAIN ROOFING TILES.

No. 473—1932. This specification departs in many respects from previous specifications for concrete units. The properties which constitute a good concrete roofing tile were determined from exhaustive investigations conducted over a period of three years, and simple tests have been devised for proving them. The method of manufacture originally adopted on the Continent has been completely superseded and tiles are now manufactured having a uniform structure throughout.

Three standard sizes are specified, 10½in. by 6½in., 10½in. by 6½in., and 11in. by 7in., with a thickness not less than ⅜in. at the centre.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

WELLINGTON TUBE WORKS, Ltd., Great Bridge, Tipton, desires to deny rumours that it has been purchased, or absorbed by, or been amalgamated with another company.

THE BRITISH TRANE COMPANY, Ltd., has changed its address from 26, Rosebery-avenue, London, E.C.1, to Vectair House, Newcastle-place, Clerkenwell, London, E.C.1.

MR. JOSEPH MAUDSLAY, late Assistant General Manager of the Egyptian State Railways, is now associated with the Diesel Traction Department of Davey, Paxman and Co. (Colchester), Ltd.

MR. R. H. BREAKSPEAR, formerly sales manager for Charles Churchill and Co., Ltd., London (dealer section), has recently joined James Neill and Co. (Sheffield), Ltd., Composite Steel Works, Sheffield, and will be closely identified with the distribution of that company's "Eclipse" hacksaw blades, frames and, and 4 S tools, as joint sales manager of that department.

CONTRACTS.

STURTEVANT ENGINEERING COMPANY, Ltd., 147, Queen Victoria-street, London, E.C.4, inform us that they have recently received an order for the supply of two electrostatic precipitation plants for the removal of dust from gases, the volume handled totalling 14,500,000 cubic feet per hour.

AN AUTOMATIC WIRE FORMING MACHINE.—In redrawing the sketches illustrating the article describing the wire-forming machine made by James Ward, of Worcester, which appeared in our issue of January 20th, a mistake was inadvertently made in the thickness of the metal used in making the component represented in Fig. 14. The metal is No. 44 S.W.G., not No 14 as marked.

CONCOURS D'INVENTIONS.—During the forthcoming Paris Trade Fair (May 13th to 29th), a competition open to all kinds of new inventions will be held as in previous years. While there is no entrance fee, various prizes (5000f., 3000f., 2000f., 1000f., 500f., 300f., 200f., 100f.) will be awarded by a jury for the best exhibits. Applications to take part in the competition should reach the representative of the Paris Trade Fair, 143, Fleet-street, London, E.C.4, not later than March 1st, 1933.

"THE GLASGOW HERALD."—We congratulate *The Glasgow Herald* as heartily on its 150th Anniversary Supplement as on its 150th birthday. Our only regret is that a Supplement which teems with good things—reproductions of old engravings, celebrated portraits, touches of biography and history, amusing snippets, and so on—has been, of necessity, printed by newspaper methods and not by those of a book publisher. It is too large to put in a library, and the type—quite appropriate to a newspaper—is hardly worthy of that honour. Is it too much to hope that the Proprietors will reprint the Supplement in a more convenient form?

BRITISH CHEMICAL MANUFACTURERS' ASSOCIATION.—The annual dinner of the British Chemical Plant Manufacturers' Association was held on Thursday last, January 26th, at Maison Jules, Jermyn-street, under the chairmanship of Mr. Eustace A. Alliott. There was a good attendance of members and guests, which included visitors from Canada and overseas. After the dinner an interesting discussion took place on "Co-operative Selling in Overseas Markets," which was introduced and rounded off by Mr. Alliott, the chairman. Dr. E. F. Armstrong, the Chairman of the Association of British Chemical Manufacturers, gave his personal experiences of the chemical trade and its prospects of development in Canada and strongly advised collective action in the marketing of British plant. Mr. Julian Piggot, the Director of the British Steel Export Association, recounted the steps which have led up to an agreement with Canadian steel manufacturers with regard to exports of heavy steel products; while Mr. T. Nightingale, of Sheffield Steel Products, Ltd., dealt with the efforts of Sheffield manufacturers to market small steel products overseas. Among those who took part in the discussion were Mr. W. R. Gordon, the newly appointed Director of the Coal Utilisation Council, who described collective selling in India and Germany; Mr. J. Arthur Reavell, who stressed the capacity of British makers to produce all types of plant; and Mr. Ryan, of Canada, who said that British firms would find a sympathetic welcome from Canadian buyers. Mr. J. Kewley, the President of the Institute of Petroleum Technologists, instanced the petroleum industry as a good example of collective selling.

INSTITUTION OF ELECTRICAL ENGINEERS.—Considering the times, there was a very fine and representative gathering of members and guests at the annual dinner of the North-Western Section of the Institution of Electrical Engineers, which was held at the Midland Hotel, Manchester, on Tuesday, January 17th. In the absence, through indisposition, of Mr. G. F. Sills, chairman of the Section, the dinner was presided over by Mr. G. G. L. Preece, vice-chairman, and amongst those present were the Lord Mayor of Manchester (Alderman W. Walker, M.I.E.E., M.I. Mech. E.); Sir Holberry Mensforth; Mr. A. E. L. Chorlton: Dr. S. L. Pearce; Professor Marchant, President of the Institution; Professor Dempster Smith, chairman of the North-Western Branch, Institution of Mechanical Engineers, and Mr. P. F. Rowell, secretary of the Institution. The toast of "The Cities and Trades of Manchester and Salford" was proposed by Sir Holberry Mensforth, who said that the British engineering industry's future success would depend more upon craftsmanship than on mass production. In his reply to the toast, the Lord Mayor said it would not be long before the grid scheme would be completed. The toast of "The Institution of Electrical Engineers" was given by Mr. A. E. L. Chorlton, who said he believed that was the time for undertaking large public works. He said he did not include road-making, but schemes depending upon engineers that could be put into force. He also referred to the water grid scheme, which had been received with the quietness of death in Manchester. In reply, Professor Marchant advocated the electrification of the suburban railway lines. He said that the "grid" had created a considerable demand for heavy electrical installations, but that was now coming to an end, and a restricted slump in heavy products was likely. The electrification of the railways might help to obviate it. Money was now cheap, and if they were to ask the Minister of Transport for a Government guaranteed loan, there would be little chance that the Government would be called upon to meet the guarantee. The toast of "The Guests" was proposed by the chairman.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
(1) Native	15/- to 20/-
(1) Spanish	17/- to 24/-
N.E. COAST—	
Native	18/- to 21/-
Foreign (c.i.f.)	15/3

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	3 6 0	—
No. 1 Foundry	3 10 0	—
No. 3 Foundry	3 7 6	—
N.E. COAST—		
Hematite Mixed Nos.	2 19 0	2 19 0
No. 1	2 19 6	2 19 6
(f) Cleveland—		
No. 1	3 5 0	3 1 0
Siliceous Iron	3 5 0	3 1 0
No. 3 G.M.B.	3 2 6	2 18 6
No. 4 Foundry	3 1 6	2 17 6
No. 4 Forge	3 1 0	2 17 0
Mottled	3 0 6	2 16 6
White	3 0 6	2 16 6
MIDLANDS—		
(c) Staffs.—	(*Delivered to Station.*)	
All-mine (Cold-blast)	—	—
North Staffs. Forge	3 1 0	—
„ „ Foundry	3 6 0	—
(c) Northampton—		
Foundry No. 3	3 2 6	—
Forge	2 17 6	—
(c) Derbyshire—		
No. 3 Foundry	3 6 0	—
Forge	3 1 0	—
(3) Lincolnshire—		
No. 3 Foundry	—	—
No. 4 Forge	—	—
Basic	—	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	3 15 6 (*a*); 4 0 6 (*b*); 4 5 6 (*c*)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	9 15 0	9 5 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 5 0	—
Common Bars	9 5 0	—
Best Bars	10 5 0	—
Double Best Bars	10 15 0	—
Treble Best Bars	11 5 0	—
LANCS.—		
Crown Bars	9 15 0	—
Best Bars	10 5 0	—
Hoops	12 0 0	—
S. YORKS.—		
Crown Bars	9 15 0	—
Best Bars	10 15 0	—
Hoops	12 0 0	—
MIDLANDS—		
Crown Bars	8 12 6 to 9 5 0	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	8 0 0 to 8 10 0	—
Gas Tube Strip	10 7 6 to 10 10 0	—

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates (Marine)	9 0 0	8 10 0
„ „ (Land)	—	—
Ship Plates, ½in. and up	8 15 0	7 15 0
Sections	8 7 6	7 7 6
Steel Sheets, ¼in.	7 15 0	7 15 0
Sheets (Gal. Cor. 24 B.G.)	11 5 0–10 Ton	10 0 0
	Lots and Upwards Delivered Glasgow Stations.	
„ (Gal. Cor. 24 B.G.)	For Canada separately arranged	

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 15 0	7 15 0
Angles	8 7 6	7 7 6
Boiler Plates (Marine)	10 10 0	—
„ „ (Land)	10 0 0	—
Joists	8 15 0	7 7 6
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	7 2 6	—
Soft Billets	5 10 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	—
Billets	6 10 0 to 9 0 0	—
MANCHESTER—		
Bars (Round)	9 7 6	—
„ (Small Round)	6 15 0	—
Hoops (Baling)	10 0 0	9 15 0
„ (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
„ (Lancs. Boiler)	8 10 0	—
SHEFFIELD—		
Siemens Acid Billets	9 2 6 (basis)	—
Hard Basic	8 2 6 and 8 12 6	—
Intermediate Basic	6 12 6 and 7 2 6	—
Soft Basic	5 15 0	—
Hoops	9 10 0 to 9 15 0	—
Soft Wire Rods	7 10 0	—
MIDLANDS—		
Small Rolled Bars (all British)	7 0 0 to 7 5 0	—
Small Re-rolled Bars	6 15 0 to 6 17 6	—
Billets and Sheet Bars	4 17 6 to 5 7 6	—
Galv. Sheets	11 15 0 to 13 15 0	10 10 0
(2) Staffordshire Hoops	9 10 0	—
(*d*) Angles	8 7 6	—
(*d*) Joists	8 15 0	—
(*d*) Tees	9 7 6	—
(*d*) Bridge and Tank Plates	8 17 6	—
Boiler Plates	8 5 0 to 8 7 6	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14 f.o.b.	15/9 to 16/-
Block Tin (cash)	148 5 0
„ (three months)	148 15 0
Copper (cash)	28 10 0
„ (three months)	28 13 9
Spanish Lead (cash)	10 13 9
„ „ (three months)	10 18 9
Spelter (cash)	13 18 9
„ (three months)	14 1 3
MANCHESTER—	
Copper, Best Selected Ingots	32 10 0
„ Electrolytic	33 10 0
„ Strong Sheets	65 0 0
„ Tubes (Basis Price), lb.	0 0 10
Brass Tubes (Basis Price), lb.	0 0 9
„ Condenser, lb.	0 0 11½
Lead, English	12 7 6
„ Foreign	11 2 6
Spelter	14 5 0
Aluminium (per ton—raw ingot)	£95

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/10½ per lb.	
Ferro Tungsten	1/7½ per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£25 15 0	8/-
„ „ 6 p.c. to 8 p.c.	£24 10 0	7/6
„ „ 8 p.c. to 10 p.c.	£22 5 0	7/-
„ „ Specially Refined		
„ „ Max. 2 p.c. carbon	£36 10 0	11/-
„ „ „ 1 p.c. carbon	£42 12 0	14/-
„ „ „ 0·70 p.c. carbon	£44 0 0	16/-
„ „ „ carbon free	1/- per lb.	
Metallic Chromium	2/9 per lb.	
Ferro Manganese (per ton)	£10 15 0 for home	
„ „ „	£9 15 0 for export	
„ Silicon, 45 p.c. to 50 p.c.	£13 10 0 scale 5/- per unit	
„ „ 75 p.c.	£19 10 0 scale 6/- per unit	
„ Vanadium	12/6 per lb.	
„ Molybdenum	6/3 per lb.	
„ Titanium (carbon free)	9d. per lb.	
Nickel (per ton)	£245 0 0	
Ferro Cobalt	7/9 per lb.	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	15/6
„ „ Ell	16/- to 16/6
„ „ Splint	16/- to 17/6
„ „ Trebles	15/-
„ „ Doubles	12/-
„ „ Singles	10/6 to 10/9
AYRSHIRE—	
(f.o.b. Ports)—Steam	14/-
„ „ Jewel	16/6
„ „ Trebles	15/6
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	13/- to 15/-
Screened Navigation	16/6 to 17/6
Trebles	15/6 to 16/-
Doubles	12/6 to 13/6
Singles	10/9
LOTHIANS—	
(f.o.b. Leith)—Best Steam	13/6 to 14/-
Secondary Steam	13/6
Trebles	15/6
Doubles	11/9
Singles	10/6

(8) N.W. COAST— ENGLAND.

Steams	19/- to 23/6
Household	32/6 to 52/6
Coke	18/- to 21/-
NORTHUMBERLAND—	
Best Steams	14/6
Second Steams	12/6 to 12/9
Steam Smalls	8/6
Unscreened	12/6 to 13/-
Household	27/- to 39/-
DURHAM—	
Best Gas	14/6
Second	13/3 to 13/6
Household	25/- to 37/-
Foundry Coke	24/-

SHEFFIELD	Inland.
Best Hand-picked Branch	27/- to 28/-
South Yorkshire Best	23/- to 24/-
South Yorkshire Seconds	18/- to 21/-
Derbyshire Best House	22/- to 23/6
Derbyshire Best Brights	18/- to 20/-
Screened Seconds	17/6 to 19/-
Kitchen Coal	16/6 to 17/6
Best Screened Nuts	17/- to 18/6
Small Screened Nuts	16/- to 16/6
Yorkshire Hards	17/- to 18/-
Derbyshire Hards	17/- to 18/-
Rough Slacks	8/6 to 9/6
Nutty Slacks	7/- to 8/6
Blast-furnace Coke (Inland)	10/- on rail at ovens
Furnace and Foundry Coke (Export), f.o.b.,	14/6 to 15/6

(9) SOUTH WALES.

CARDIFF—	
Steam Coals :	
Best Smokeless Large	19/6 to 19/9
Second Smokeless Large	18/9 to 19/6
Best Dry Large	19/- to 19/6
Ordinary Dry Large	17/9 to 18/3
Best Black Vein Large	18/3 to 18/6
Western Valley Large	17/9 to 18/-
Best Eastern Valley Large	17/7½ to 17/9
Ordinary Eastern Valley Large	17/3 to 17/6
Best Steam Smalls	13/- to 13/6
Ordinary Smalls	11/- to 13/-
Washed Nuts	20/- to 32/-
No. 3 Rhondda Large	19/6 to 19/9
„ „ Smalls	15/- to 16/-
No. 2 „ Large	17/- to 17/3
„ „ Through	15/6 to 16/-
„ „ Smalls	14/- to 14/3
Foundry Coke (Export)	22/6 to 36/6
Furnace Coke (Export)	15/6 to 16/6
Patent Fuel	22/-
Pitwood (ex ship)	20/6 to 21/6
SWANSEA—	
Anthracite Coals :	
Best Big Vein Large	36/- to 38/6
Seconds	27/- to 34/-
Red Vein	22/- to 26/6
Machine-made Cobbles	36/6 to 48/6
Nuts	36/6 to 48/6
Beans	28/6 to 32/6
Peas	19/- to 20/-
Breaker Duff	8/6 to 9/-
Rubbly Culm	8/6 to 9/-
Steam Coals :	
Large	20/- to 20/6
Seconds	18/- to 20/-
Smalls	11/6 to 13/-
Cargo Through	16/- to 17/6

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate: Joists (minimum), 22/6; Ordinary Ship, Bridge, and Tank Plates and Sections, 15/-, if home consumers confine purchases from associated British Steel Makers. (*e*) Delivered Black Country Stations. (*f*) Delivered North-East Coast.

French Engineering Notes.

(From our own Correspondent in Paris.)

The Steel Trade.

THE promise of more activity being imparted to the international steel trade by a demand from the Far East for bars and sheets has not been realised, and as no further orders have been received from that source the market has fallen back to its previous dull level with a slight decrease of prices. Steel producers in Belgium and Luxemburg have endeavoured to prevent a further sagging of prices below the existing unprofitable rates, but they are hard pushed by French makers who maintain quotations on their own market, where requirements are restricted, and offer supplies for shipment at Antwerp at prices which make the situation of Belgian firms extremely precarious. The effect of this competition is to show the necessity of doing something to organise the international steel trade, and at the meetings of representatives of countries that adhered to the old cartel, which have been held in Brussels, the discussion turned upon the constitution of sales comptoirs. It appears that, for the moment, the cartel itself is left in the background. The French and German steelmakers are said to have agreed upon the steel outputs from January, 1928, to October, 1929, inclusive as a period of reference in fixing the quotas for foreign trade, but the Belgians are still claiming as a reference the second half of 1932, when they made great efforts to increase their sales, while the German production was reduced to an abnormal extent.

Wagon Building.

The Conseil Supérieur des Chemins de Fer obtained permission from the Government for the railway companies to spend 490 million francs upon the purchase of rolling stock during the present year. This is a comparatively small expenditure in view of requirements, and of the almost complete absence of employment at the wagon-building shops, but it would have enabled builders to avoid closing down their works. Apparently, the money is not forthcoming, since those companies which had given out orders in anticipation of the credits have had to cancel them, and one of the largest manufacturers of railway material in the North of France is closing down the wagon-building department. Another big firm in the Charente Inférieure has been accumulating so many standard types of coaches that orders for them could be filled out of stock for a long time to come. The situation appears incomprehensible in view of the fact that wagon builders have long possessed a financial organisation which enables them to supply rolling stock on credit, whereby payment can be extended over periods acceptable to the Government. It was also hoped that the situation would be improved by the recent Government Budget proposal to reduce the 32·5 per cent. on passenger fares, which was imposed as an emergency measure in 1926 to save the franc from its catastrophic collapse, and to revert to the old 12 per cent. tax, but this and other proposals to alleviate the situation of the railway companies are being held up by the financial crisis.

Wood in Shipbuilding.

It is now being asked whether the official reaction against recent disasters has not carried the partial prohibition of wood in the construction of ships too far. The authorities have not gone to the extent of a total exclusion of wood as suggested at first, but they have proposed limitations which may cause embarrassment to those responsible for the fitting up of ships in a way to attract passengers. The Minister of the Merchant Marine thought that fire-resisting substitutes could be found for wood. There are plenty of them, though no one can say that they have proved their worth, and as foreign shipping companies have not thought it necessary to dispense with wood the French fear that if they prohibit the use of a material which is so well adapted to ship-furnishing requirements, they may find themselves at a disadvantage in the competition for traffic. The timber and forestry industries have made strong protests to the Minister of the Merchant Marine against the exclusion of wood, and insist that they should be represented on the Commission which is to decide upon the materials to be used for the fitting up of ships. It is argued that wood cannot be excluded, and that with varnishes of low inflammability, the risk of fire would be reduced to a minimum if precautions were taken to isolate immediately any outbreak and to deal with it effectively. In the case of the "Georges Philippar," the captain only knew that there was a fire twenty minutes after the outbreak. The new regulations and recommendations for ensuring safety against fire were adopted as an emergency measure largely with a view to allaying public nervousness, but hasty solutions will necessarily be modified during the technical inquiry now being carried out into the whole question of ensuring the maximum of security against fire on board ship.

Colonial Works.

Profiting from the permission granted them by Parliament to raise loans for development work, the Colonial Governments are continuing railway construction and other undertakings, and in Madagascar it has been decided to spend 70 million francs on the construction of a mole at the port of Majunga. It will be protected by a breakwater 650 m. long, and the mole will be in 10 m. of water for a distance of 250 m. on one side, and, on the other side, wharfage will be provided for steamers drawing not more than 6 m. In Equatorial Africa work is being continued on the railway between Brazzaville and the port of Pointe-Noire. It is expected that this particularly arduous and difficult undertaking will be completed before the end of next year. In North Morocco, the El Kansera dam across the river Beth will also be completed next year, when it will impound 230 million cubic metres of water. The depth of water at the dam will be 50 m. The supply will be used to irrigate 50,000 acres of land, and a power station will provide energy for the Morocco railway. The barrage is built on a rock foundation with fissures that necessitated a considerable injection of liquid cement. The cost of the work will be 110 million francs.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

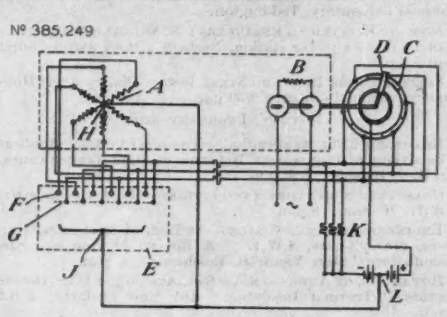
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

DYNAMOS AND MOTORS.

385,249. August 23rd, 1932.—ELECTRIC REPULSION MOTORS, Aktiengesellschaft Brown, Boveri et Cie, of Baden, Switzerland.

The invention relates to a single-phase A.C. repulsion motor in which the rotor is fed directly from the A.C. network, while the stator is short-circuited over a controlled rectifier. Such motors may be completely controlled both as regards the direction of rotation and the speed of revolution simply by displacing the associated controlling member. A is the polyphase stator winding of the motor, which is provided with a star point, and B the single-phase winding of the rotor, which is fed directly by the current of the network. C is the controlling member with the rotary brush D, E the mercury vapour rectifier, the anodes F of which are provided with controlling grids G. The winding

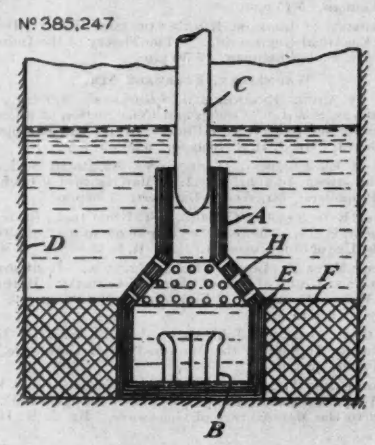


A is connected to the anodes F, and its star point H to the cathode J. The segments of the controlling member or distributor C are connected to the grids G, which are also connected permanently over resistances K with the negative pole of a battery L. From the positive pole of the battery a conductor leads to the inner slip ring of the distributor and the rotary brush connects alternately and in cyclic sequence with the positive pole of the battery. When the brush is driven from the motor shaft, the controlling potential is supplied to the grids in synchronism with the revolution frequency of the motor, the current being allowed to flow through in each case to that stator phase which is displaced with respect to the momentary position of the rotor. The current flowing through this phase develops with the rotor field the requisite motor torque.—*December 22nd*, 1932.

SWITCHGEAR.

385,247. August 22nd, 1932.—ELECTRIC SWITCHES OF THE EXPLOSION CHAMBER TYPE, *International General Electric Company, Incorporated, of* 120, *Broadway, New York, U.S.A.*

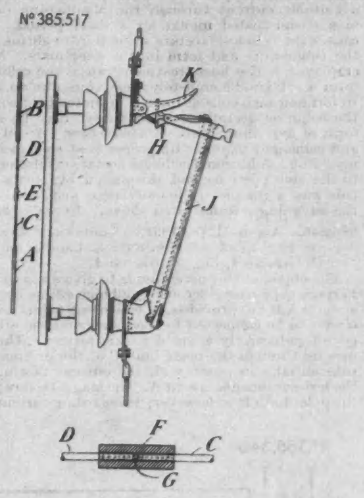
The switch described in this specification is of the type in which the contacts are separated from one another during operation under water. A cylindrical vessel of insulating material contains an insulating tube A and a fixed contact B. The insulating tube forms at its upper end a narrow guide for a



movable contact rod C. The lower portion of the vessel D surrounding the explosion chamber E is filled up with a solid insulating material F, whilst the upper portion is filled with water. The water level is above the mouth of the tube A by a distance at least equal to the diameter of the tube. Where the tube A merges into the extinguishing chamber E there are several openings H through which the gases formed on switching can pass into the water. The openings may be distributed over the entire insulating tube.—*December 22nd*, 1932.

385,517. September 26th, 1931.—ELECTRIC FUSE LINKS, Southern States Equipment Company, of Birmingham, Jefferson, State of Alabama, U.S.A.

A special fusible conductor appears to be the principal feature of this invention. It consists of two long flexible end conductors A B of equal length and high conductivity, to which are soldered two separate short intermediate conductors C D of high resistance. These are joined together by a soldered joint E which is made up of a tubular sleeve F surrounding the adjacent ends of the two conductors C D, all being held together by a low-melting solder G, making the joint of good conductivity. The ends of the conductors within the sleeve are preferably deformed by slight corrugations, so that they have greater resistance against longitudinal tension than straight cylindrical conductors. When a moderate overload occurs the conductors C D are heated and the joint is heated by conduction to a temperature at which solder melts. The member H thereupon pulls one end of the conductor out of the sleeve F, thereby establishing a gap in the line and interrupting the flow of current by the well-known expulsion tube method. It will be gathered that the insulating tube J can swing from the closed position to the open position shown. The device H is described

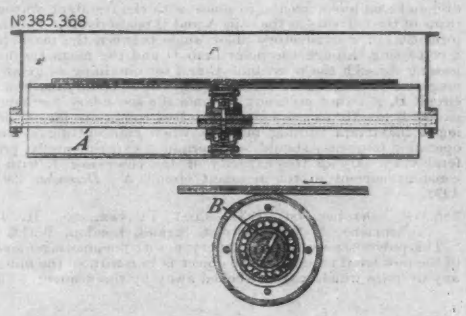


as a latch. When the link is closed it engages with a keeper K, but the description of this part of the link is somewhat vague.—*December 29th*, 1932.

CRANES AND CONVEYORS.

385,368. September 22nd, 1931.—SHEAVES FOR CONVEYOR BELTS, *A. H. Stevens*, 5, *Quality-court, Chancery-lane, London, W.C.2.*

The object of this invention is to keep a long belt conveyor running straight regardless of exterior influences. At appropriate intervals there are arranged idler sheaves of the form

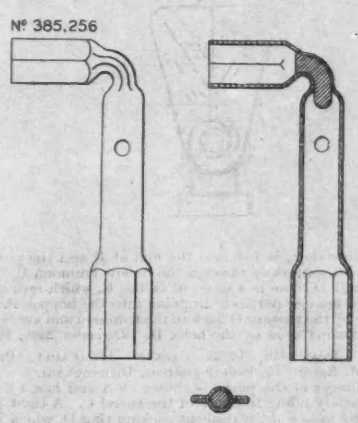


shown in the drawing. The essential feature is that the ball bearing, which carries the idler, is fixed to the stationary shaft A by means of the transverse pin B. This pin is set at an angle of approximately 45 deg. to the direction of travel of the belt. The result is an action similar to that of a castor, which allows the idler to swing out of line and draw the belt back into the straight path.—*December 29th*, 1932.

MACHINE TOOLS AND SHOP APPLIANCES.

385,256. October 5th, 1932.—BOX SPANNERS, F. Laiter, 10, bis Rue du Montoir, Clamart, Seine, France.

It is desired to bend the shank of a double-ended box spanner at right angles, as shown in the drawing. The shank, at its



full diameter, cannot be bent without distress, so its diameter is reduced by crimping in the sides, as shown in the cross section. A solid filling piece is introduced at the restricted part of the tube and the bend then made. The fins help to stiffen the bend against torsional stresses.—*December 22nd*, 1932.

MISCELLANEOUS.

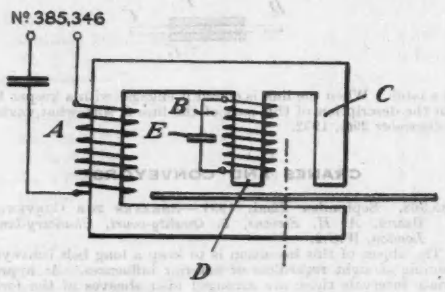
385,252. September 17th, 1932.—METHODS OF MANUFACTURING ELECTRICAL COILS, the British Thomson-Houston Company, Ltd., Crown House, Aldwych, London, W.C.2.

A method is described in this specification of effectively insulating a coil without the use of absorbent or fibrous materials or insulating varnishes, and with a minimum amount of material and labour. The method is also claimed to produce a compact coil which is absolutely free from moisture and which is insulated with a material which, because of the operations performed on it and its peculiar characteristics, provides solid insulation which is impervious in character, and of high dielectric strength with a small insulation space factor. The insulation material employed is a cellulose ester, such as cellulose acetate, used in the form of thin, dry sheets of, say, 3 mils or less in thickness.

The cellulose acetate is applied to the conductors as a tape, for example, and the conductors are formed into coils of the proper shape, employing, if desired, additional cellulose acetate as layer insulation between turns. The cellulose acetate is next rendered thermo-plastic by either internal baking, as by passing a suitable current through the conductors, or by moulding in a steam-heated mould for a short period. The operation causes the cellulose acetate insulation to shrink tightly around the conductors and form into a solid mass. No solvents are employed. The heat treatment causes the cellulose acetate to form a solid and completely impervious film on the conductors. In forming such coils as induction motor field coils, for example the cellulose acetate or similar ester may be spiralled in the form of dry, thin sheets on conductors. A coil is then formed and cemented together by proper heat treatment, as by steam moulding. Additional cellulose acetate insulation is then applied to the slot portions and shrunk on by steam moulding. In this way a completely homogeneous insulation is applied with the advantages enumerated above.—*December 22nd*, 1932.

385,346. August 12th, 1931.—RESONANCE RELAY ACCORDING TO THE FERRARIS PRINCIPLE, Landis und Gyr S.A., of Hofstrasse 1, Zug, Switzerland.

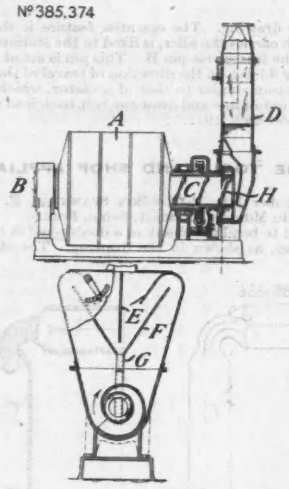
The object of this invention is to give a resonance relay of the Ferraris type great selectivity and high efficiency. Two resonance circuits A B are provided, of which one forms a series resonance circuit to be connected to the mains and the other a secondary circuit inductively coupled to the former. The magnetic flux passing through the polar limb C of the driving magnet core is substantially in phase with the current flowing in the coil of the series resonance circuit A. The magnetic flux passing through the polar limb D is, however, disregarding currents in the driving



disc and iron-loss currents, in phase with the resultant ampère turns of the currents in the coils A and B respectively. For the formation of a satisfactory phase angle between the magnetic flux passing through the polar limb D and the magnetic flux passing through the polar limb C and for obtaining as great a magnetic flux as possible determined by the secondary resonance circuit B, it is not necessary to tune the secondary resonance circuit B exactly to resonance. The best conditions for obtaining a maximum turning moment when transmitting at the operating frequency should be determined experimentally, preferably by varying the capacity of the condenser E with a constant current in the resonant circuit A.—*December 29th*, 1932.

385,374. October 1st, 1931.—COAL PULVERISERS, H. D. Tollemache, 4, Norfolk-street, Strand, London, W.C.2.

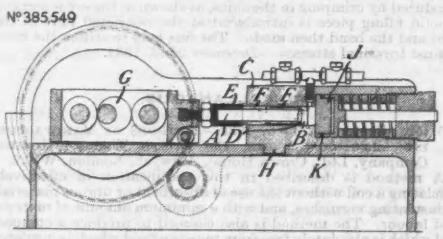
This pulveriser is of the ball mill type, with pneumatic removal of the powdered product. The object is to return to the mill A any oversize which may be sucked away by the draught. The



coal, for instance, is fed into the mill at B and the powdered product is drawn away through the hollow trunnion C. In the upcast shaft D there is a series of baffles E, which result in the larger and heavier particles dropping into the hopper F. They gravitate by the passage G back to the trunnion and are returned to the grinding zone by the helix H.—*December 29th*, 1932.

385,549. July 14th, 1932.—PACKING HYDRAULIC PISTONS, M. M. Eaton, 18, Brearley-street, Birmingham.

The plunger of the pump is shown at A and has a flange B approximately filling the bore of the barrel C. A tight joint is effected by means of the resilient packing ring D, which is compressed by the spring E and the sleeves F F. The operation of



the plunger by the cam G is obvious, and a trunnion is arranged at H so that the pump cylinder may be swung out of working position for adjustments. In the event of the pressure in the working cylinder exceeding safe limits it is relieved by the recession of the spring-loaded piston J, which also has a spring-compressed packing ring K.—*December 29th*, 1932.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Monday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

JUNIOR INST. OF ENGINEERS.—39, Victoria-street, S.W.1.—"Dredging for Alluvial Tin," Mr. H. W. Sewell. 7.30 p.m.

N.E. COAST INST. OF ENGINEERS AND SHIPBUILDERS.—Meeting cancelled.

PHYSICAL SOCIETY.—Imperial College of Science and Technology, Imperial Institute-road, S. Kensington, S.W.1. Council meeting, 4 p.m. Meeting at 5 p.m.

ROYAL INST. OF GREAT BRITAIN.—21, Albemarle-street, W.1. Discourse, Mr. Cyril Norwood. 9 p.m.

SOUTHERN RAILWAY PUPILS' AND PREMIUM APPRENTICES' ASSOCIATION.—Charing Cross Hotel, W.C.2. Annual dinner. Tickets may be obtained from Mr. E. Forge, 159, Desborough-road, Eastleigh.

SATURDAY, FEBRUARY 4TH.

INST. OF BRITISH FOUNDRYMEN: LANCASHIRE.—Grand Hotel, Manchester. Annual Whist Drive, Dinner and Dance. 4 p.m. to Midnight.

INST. OF CIVIL ENGINEERS.—Students' visit to National Physical Laboratory, Teddington.

INST. OF ELECTRICAL ENGINEERS: S. MIDLAND STUDENTS.—Visit to Princes power station, Nechells. Meet Aston Church-road. 3 p.m.

STAFFORDSHIRE IRON AND STEEL INST.—Dudley Arms Hotel, Dudley. Annual dinner. 6.30 p.m.

MONDAY, FEBRUARY 6TH.

BRADFORD ENGINEERING SOC.—Technical College, Bradford. "Behaviour of Engineering Materials at High Temperatures," Mr. R. G. Batson. 7.30 p.m.

CHARTERED SURVEYORS' INSTITUTION.—12, Gt. George-street, S.W.1. Meeting. 8 p.m.

ENGINEERS' GERMAN CIRCLE.—At Inst. of Mechanical Engineers, Storey's-gate, S.W.1. "A Review of Iron and Steel Manufacture," Herr Victor B. Reichwald. 6 p.m.

ROYAL SOC. OF ARTS.—John-street, Adelphi, W.C.2. Howard Lecture, "Thermal Insulation," Dr. Ezer Griffiths, F.R.S. 8 p.m.

SOC. OF CHEMICAL INDUSTRY.—In Chemical Society's Room, Burlington House, W.1. "Harmones," Prof. E. C. Dodds. 8 p.m.

SOC. OF ENGINEERS.—At Geological Society, Burlington House, W.1. Presentation of premiums awarded, 1932. Presidential address, Mr. J. D. Haworth. 6 p.m.

WOLVERHAMPTON AND DISTRICT ENGINEERING SOC.—Victoria Hotel, Wolverhampton. Debate, "Boiler and Furnace Firing." 7.30 p.m.

TUESDAY, FEBRUARY 7TH.

BRADFORD EDUCATION COMMITTEE.—Technical College, Bradford. "Design of Welded Structures," Mr. C. Helsby. 7.30 p.m.

BRITISH ASSOCN. OF REFRIGERATION.—At Inst. of Mechanical Engineers, Storey's-gate, S.W.1. "Refrigerated Railroad Transport of Meat and Produce," Mr. W. Glossop. 5.30 p.m.

DIESEL ENGINE USERS ASSOCIATION.—Coventry Restaurant, Wardour-street, W.1. Annual dinner. 7 for 7.30 p.m.

INST. OF AUTOMOBILE ENGINEERS.—At Royal Soc. of Arts, John-street, Adelphi, W.C.2. "Some Problems in Chassis Design," Mr. L. H. Dawtrey. 7.45 p.m.

INST. OF CIVIL ENGINEERS.—Gt. George-street, S.W.1. "Power-house Foundations and Circulating-water Tunnels at the Ford Motor Company's Works, Dagenham," Messrs. R. V. Allin and M. Nachshen. 6 p.m.

ROYAL INST. OF GREAT BRITAIN.—21, Albemarle-street, W.1. "Low Temperatures and Low Temperature Phenomena," Mr. J. C. M'Lennan. 5.15 p.m.

UNIVERSITY OF LONDON, KING'S COLLEGE, W.C.2.—Department of Electrical Engineering. "The Theory of the Induction Motor," Dr. F. T. Chapman. 5.30 p.m.

WEDNESDAY, FEBRUARY 8TH.

INST. OF CIVIL ENGINEERS: STUDENTS' MEETING.—Gr. George-street, S.W.1. "Design and Construction of a Covered Concrete Service Reservoir at Plumstead, for the Metropolitan Water Board," Mr. J. H. T. Stilgoe. 6.30 p.m.

INST. OF ENGINEERING INSPECTION.—At Royal Society of Arts, John-street, Adelphi, W.C.2. "Manufacture of High-class Marine Propellers," Mr. Wesley Lambert. 5.30 p.m.

INST. OF ENGINEERS-IN-CHARGE.—St. Bride Inst., Bride-lane, Fleet-street, E.C.4. "Modern Developments in Air Compressors and in the Use of Compressed Air," Mr. R. L. Quertier. 7.30 p.m.

INST. OF METALS: LONDON LOCAL SECTION.—Joint meeting with the Food Group of Soc. of Chemical Industry. Burlington House, W.1. Discussion, "Non-ferrous Metals in the Food Industry." 8 p.m.

ROYAL SOC. OF ARTS.—John-street, Adelphi, W.C.2. "Design and Form as Applied to the Manufacture of Glassware," Mr. J. H. Hogan. 8 p.m.

SOC. OF GLASS TECHNOLOGY: LONDON SECTION.—At Royal Soc. of Arts, John-street, Adelphi, W.C.2. "Design and Form in Relation to the Manufacture of Glassware," Mr. J. H. Hogan. 8 p.m.

TELEVISION SOC.—University College, Gower-street, W.C.1. "The New Gas Discharge Tubes and their Application to Television," Mr. Norman L. Harris (G.E.C.'s Research Laboratories). 7 p.m.

THURSDAY, FEBRUARY 9TH

INST OF MARINE ENGINEERS: JUNIOR SECTION.—The Minories, E.C.3. "The Maintenance of Marine Refrigerating Plant," Mr G. Ormiston. 7 p.m.

INSTITUTION OF STRUCTURAL ENGINEERS.—10, Upper Belgrave-street, S.W.1. "Creep on Concrete Under Load," Dr. W. H. Glanville. 6.30 p.m.

FRIDAY, FEBRUARY 10TH.

CHEMICAL ENGINEERING GROUP.—In Rooms of Chemical Soc., Burlington House, W.1. "Creep in Steels," Mr. H. J. Tapsell. 8 p.m.

INST. OF METALS.—The University, Sheffield. "Soft Solders and Fluxes," Dr. O. F. Hudson. 7.30 p.m.

JUNIOR INST. OF ENGINEERS.—39, Victoria-street, S.W.1. "Oil from Coal," Dr. C. H. Lander. 7.30 p.m.

N.E. COAST INST. OF ENGINEERS AND SHIPBUILDERS.—Bolbec Hall, Newcastle-upon-Tyne. "Destroyer Forms," Mr. J. L. Scott. "Approximating E.H.P.: Notes of Amendments to Data Given in 1927 Paper," Mr. A. L. Ayre.

SHEFFIELD METALLURGICAL ASSOCIATION.—Royal Victoria Hotel, Sheffield. Supper-dance. 7.30 p.m. to 1 a.m.

ROYAL INST. OF GREAT BRITAIN.—21, Albemarle-street, W.1. Discourse, Mr. A. V. Hill. 9 p.m.

MONDAY, FEBRUARY 13TH.

INST. OF METALS.—At 39, Elmbank-crescent, Glasgow. "Modern Light Alloys, with Particular Reference to Corrosion," Dr. Leslie Aitchison. 7.30 p.m.

TUESDAY, FEBRUARY 14TH.

INST. OF AUTOMOBILE ENGINEERS.—King's Head Hotel, Coventry. "Some Problems in Chassis Design," Mr. L. H. Dawtrey. 7.45 p.m.

INST. OF MARINE ENGINEERS.—The Minories, E.C.3. "The Modern Trend in Marine Steam Practice," Mr. John Neill. 6 p.m.

INST. OF METALS.—Armstrong College, Newcastle-upon-Tyne. "Refractory Materials and the Non-ferrous Industries," Mr. A. B. Searle. 7.30 p.m.

INST. OF METALS.—Y.M.C.A., Swansea. "Platinum Metals," Mr. R. H. Atkinson. 6.15 p.m.

UNIVERSITY OF LONDON, KING'S COLLEGE, W.C.2.—Department of Electrical Engineering. "The Theory of the Induction Motor," Dr. F. T. Chapman. 5.30 p.m.

WEDNESDAY, FEBRUARY 15TH.

INST. OF AUTOMOBILE ENGINEERS.—Metropole Hotel, Leeds. "Some Problems in Chassis Design," Mr. L. H. Dawtrey. 7.15 p.m.

INST. OF CIVIL ENGINEERS.—Gt. George-street, S.W.1. Informal meeting. Discussion, "Ship Propulsion by Mechanical or Electrical Transmission," Mr. J. Hamilton Gibson. 6 p.m.

THURSDAY, FEBRUARY 16TH.

INST. OF ELECTRICAL ENGINEERS.—Grosvenor House, Park-lane, W.1. Annual dinner and reunion. 7 p.m. for 7.30 p.m.

INST. OF STRUCTURAL ENGINEERS.—Hotel Metropole, Leeds. "Some Notes on Floor Construction," Mr. E. S. Andrews. 7 p.m.

FRIDAY, FEBRUARY 17TH.

INST. OF CHEMICAL ENGINEERS.—Hotel Victoria, Northumberland-avenue, W.C.2. Eleventh annual meeting and annual dinner. Annual meeting, 11 a.m. Presidential address, "Chemical Engineering and the Soap Industry," the Rt. Hon. the Viscount Leverhulme, 11.45 a.m. Luncheon, 12.45 p.m. "Metallurgy from the Standpoint of the Chemical Engineer," Mr. L. Singlehurst-Ward, 2.15 p.m. King Edward VII. Rooms, annual dinner, 7 for 7.30 p.m.

INST. OF MECHANICAL ENGINEERS.—Storey's-gate, St. James's Park, London. Annual general meeting. The Annual Report of the Council will be presented. Declaration of Election of Council. Paper for discussion, "The Production of a Vacuum in an Air Tank by Means of a Steam Jet," Mr. F. R. B. Watson. 5.30 p.m.

INST. OF SANITARY ENGINEERS.—Caxton Hall, S.W.1. Sessional meeting. 6 p.m.

JUNIOR INST. OF ENGINEERS.—39, Victoria-street, S.W.1. "Episodes, Both Grave and Gay, in Engineering History," Eng.-Captain E. C. Smith. 7.30 p.m.

MANCHESTER ASSOC. OF ENGINEERS.—Engineers' Club, 17, Albert-square, Manchester. Annual dinner. 6.45 p.m. for 7.15 p.m.

RAILWAY CLUB.—57, Fetter-lane, E.C.4. Annual general meeting. Presidential address. 7.30 p.m.

MONDAY, FEBRUARY 20TH.

ENGINEERS' GERMAN CIRCLE.—At Inst. of Mechanical Engineers, Storey's-gate, S.W.1. "New Developments in the Design of Rolling Mill Equipment," Herr Dip.-Ingenieur Ernst Kugel. 6 p.m.

INST. OF AUTOMOBILE ENGINEERS.—At 39, Elmbank-crescent, Glasgow. "An Experimental Investigation of Flow in Oil-engine Injection Systems," Dr. S. J. Davies. 7.30 p.m.

WOLVERHAMPTON AND DISTRICT ENGINEERING SOC.—Victoria Hotel, Wolverhampton. "Modern Developments in Bridge Building," Mr. F. H. Abrahams. 7.30 p.m.

MONDAY, FEBRUARY 20TH, TO FRIDAY, MARCH 3RD.

BRITISH INDUSTRIES FAIR, 1933.—London and Castle Bromwich, Birmingham. Daily.

TUESDAY, FEBRUARY 21ST.

INST. OF AUTOMOBILE ENGINEERS.—Victoria Hotel, Wolverhampton. "Some Problems in Chassis Design," Mr. L. Dawtrey. 7.30 p.m.

OLD CENTRALIANS.—Devereux Restaurant, Devereux-court, W.C.2. Luncheon. 1 p.m.

UNIVERSITY OF LONDON, KING'S COLLEGE, W.C.2.—Department of Electrical Engineering. "The Theory of the Induction Motor," Dr. F. T. Chapman. 5.30 p.m.

WEDNESDAY, FEBRUARY 22ND.

INST. OF AUTOMOBILE ENGINEERS.—At Engineers' Club, Albert-square, Manchester. "Some Problems in Chassis Design," Mr. L. H. Dawtrey. 7 p.m.

FRIDAY, FEBRUARY 24TH.

INST. OF PROFESSIONAL CIVIL SERVANTS.—At Royal Soc. of Arts, John-street, Adelphi, W.C.2. "Air Photography and Archæology," Mr. O. G. S. Crawford. 5.30 p.m.

SATURDAY, FEBRUARY 25TH.

INST. OF MUNICIPAL AND COUNTY ENGINEERS: S. EASTERN DISTRICT MEETING.—At Purley. Assemble Council Offices, Purley. 11 a.m

MONDAY, FEBRUARY 27TH.

INST. OF MECHANICAL ENGINEERS: GRADUATES' SECTION.—Storey's-gate, S.W.1. "Plain Bearings," Mr. J. Robinson. 6.45 p.m.

FRIDAY, MARCH 3RD.

INST. OF MECHANICAL ENGINEERS.—Storey's-gate, S.W.1. Informal meeting. Discussion, "Modern Steam Propulsion for Ships," to be introduced by Major William Gregson. 7 p.m.

SUNDAY, MARCH 5TH, TO SUNDAY, MARCH 12TH.

LEIPZIG SPRING FAIR.—Daily.

MONDAY, MARCH 6TH.

ROYAL SOC. OF ARTS.—John-street, Adelphi, W.C.2. Cantor Lecture. "Welding and Allied Processes for Engineering Purposes," Mr. Arthur Stephenson. 8 p.m.

MONDAY, MARCH 13TH.

ROYAL SOC. OF ARTS.—John-street, Adelphi, W.C.2. Cantor Lecture. "Welding and Allied Processes for Engineering Purposes," Mr. Arthur Stephenson. 8 p.m.

FRIDAY, MARCH 17TH.

CHEMICAL ENGINEERING GROUP.—Joint meeting with Birmingham Section. "Personnel in Industry," Mr. Calder.

INST. OF STRUCTURAL ENGINEERS.—Mayfair Hotel, W.1. Annual dinner.

MONDAY, MARCH 20TH.

ROYAL SOC. OF ARTS.—John-street, Adelphi, W.C.2. Cantor Lecture. "Welding and Allied Processes for Engineering Purposes," Mr. Arthur Stephenson. 8 p.m.

MONDAY, APRIL 3RD.

BRADFORD EDUCATION COMMITTEE.—Technical College, Bradford. "Lead Burning and Copper and Iron Welding for Plumbers and Heating Engineers," Mr. E. B. Partington. 7.30 p.m.

A Seven-Day Journal

The Salter Report.

SOME observations by the Council of the Association of Municipal Corporations on the Salter Report were published last Monday. The General Purposes Committee of the Council, before issuing the observations, conferred with representatives of the Municipal Tramways and Transport Association and examined the replies of the Salter Conference to the various criticisms of the Report which had been made. According to the submission of the Council, the assumption that annual current road expenditure is £60,000,000 is incorrect, while the principle that the total contribution payable by all classes of mechanically propelled vehicles in the form of licence duty or petrol duty should be equal to the current road expenditure is regarded as fallacious. It is further submitted that, according to the Report of the Departmental Committee on Local Expenditure, road expenditure will be reduced this year as compared with the last five and is likely to be reduced in the future, and that therefore the figure for expenditure is likely to be less than the total amount received from petrol tax and licence duties at present. Adopting the formula suggested by the Salter Conference, it is assumed that the £60,000,000 would be allocated in the proportion of £23,500,000 to commercial goods and £36,500,000 to all other mechanically propelled vehicles. The Association sees no reason for dissenting from the view that commercial goods vehicles should pay increased duties as the first figure indicates, but it states that the other figure, £36,500,000, is already exceeded by the proceeds of licence and petrol duties. If the question ever arose as to the proper allocation of the £36,500,000 between cars and public service vehicles, the Association would be unable to accept the system proposed by the Report, since other important factors besides ton-mileage and petrol consumption should be taken into account. Private cars are largely a luxury, while public service vehicles are a necessity, and while the former can use all highways the latter are restricted to those prescribed by the Traffic Commissioners.

Distribution.

THE establishment of a British Distribution Committee was proposed at the end of last week in the report of a sub-committee appointed by Lord Luke, Chairman of the British National Committee of the International Chamber of Commerce, to make proposals for the examination of the conditions of distribution existing in this country. The members of the sub-committee considered that improvements in our distributive technique were possible and were a matter of national concern. The proposed Distribution Committee would collect data bearing upon the subject; co-ordinate efforts for improving such data and, where necessary, conduct specific investigations. Discussing the importance of distribution, the report states that the industry employs nearly two million persons and that the number increased between 1924 and 1930 by over 50 per cent. About one-half the income of the country passes over shop counters and more than half of this amount is probably expended on distribution costs. Differences in efficiency are wide, ranging from that of retail, wholesale, and manufacturing concerns, in which it could scarcely be increased to that of small ineffective firms and tiny retailers. An estimate which, it is admitted, is little more than a guess, suggests that although the small independent shop accounts in numbers for as much as 90 per cent. of the total, the large stores are responsible for over 45 per cent. of the trade. The proposed study is regarded as one of the most important ever undertaken in connection with British commerce and industry. The sub-committee considers that a permanent staff would be required and that the necessary organisation would cost between £4000 and £5000 per annum for a minimum period of three years.

The Duddell Medal.

THE Council of the Physical Society has awarded the tenth Duddell Medal to Professor Wolfgang Gaede, Director of the Physical Institute at Karlsruhe, and until recently Professor of Physics at the Karlsruhe Technische Hochschule. Professor Gaede's name is associated with the designing and production of high vacuum pumps, which during the last quarter of a century have revolutionised the art of vacuum production. Before 1905 the production of a vacuum beyond that attainable with a filter pump or piston pump was a tedious operation, carried out almost always with a mercury pump of the Toepler or Sprengel type. The remarkable thing about Gaede's investigations, is that, not merely that at the age of twenty-seven he designed a rotary mercury pump which was simple, easy to work, and marked a great advance, but that since that time he has produced at intervals a wide range of vacuum pumps, each with a definite field of utility, and some of which are based on wholly new principles developed largely by Gaede himself. Within the last ten years Gaede has designed a family of pumps of several stages, incorporating both the high vacuum and the fore-vacuum pump into a single unit. A recent outstanding development is the large single-stage diffusion pump designed by Gaede for work at Leiden on solid helium. This has the remarkable speed of several hundred litres per second at a pressure of 1/1000 mm. mercury. Whilst it would not be correct to say that Gaede has been alone in designing the high vacuum pumps now in common use, it should be recognised that he provided the basis on which many others are built, and that he independently introduced all the methods which are used in present-day pumps.

East Coast Ports.

INTEREST in the use of East Coast ports for purposes of coastwise traffic has been aroused by the announcement of the arrangements made by the Free Trade Wharf Company, Ltd., for a regular bi-weekly service between London, Ipswich, King's Lynn Docks, and Boston, which started on Saturday last, February 4th. The steamers call at King's Lynn and use a berth in the Alexandra Dock, which has recently been modernised and fitted with electric cranes, these improvements forming part of a scheme of development by the King's Lynn Docks and Railway Company. The quay and sheds on the north side of the dock have been rebuilt, and a large general cargo trade is now conducted with Rotterdam. The North European timber trade is also an important item in the business of the docks, while coastwise there is a considerable trade in oil, sugar, and other commodities. Recently accommodation has been secured by a firm of roadstone contractors for the discharge of materials. The dock company, we learn, has other improvements in view, and it is hoped that the new movement towards the revival of coastwise traffic will assist in further justifying a policy which has already helped to re-establish the position of King's Lynn as a gateway to the Eastern and Midland counties. While the immediate surroundings of the port are agricultural, it is also within easy reach of the manufacturing districts of the Midlands, which provide a large proportion of its trade.

Waterloo Bridge.

AT a meeting of the London County Council on Tuesday, February 7th, the Improvements Committee reported its decision to recommend, with reluctance, the Government scheme for widening Waterloo Bridge to take four lines of traffic. The opinion was expressed by the Committee that, in its view, the scheme for a new bridge, with six lines of traffic, was better, but, in the circumstances, the Government scheme must be accepted. The report of the Committee was moved by Sir Percy Simmons, who dealt at some length with the history of the negotiations with the Government concerning the Waterloo and Charing Cross bridges. Sir Percy said that while he thought that the Government's reconditioning scheme was unsound something had to be done, and the only way out of the difficulty was to adopt the suggestion of the Government to recondition the present bridge at an estimated cost of £685,000, of which the Ministry of Transport would find 60 per cent. An amendment in favour of the construction of a new bridge with not more than five arches, which would carry six lines of traffic, was defeated by seventy-three votes to thirty-five, and the Government's recommendation was carried.

New Ships.

DURING the past week the announcement was made that Sir Joseph W. Isherwood has ordered three cargo vessels to be built on his new Arcform lines, for which tank tests at the National Physical Laboratory at Teddington has shown remarkable results over a wide range of speeds. One ship will be built by the Furness Shipbuilding Company, Ltd., of Haverton Hill-on-Tees, a second by Short Brothers, Ltd., of Sunderland, and a third by Lithgows, Ltd., of Port Glasgow. Three further ships are likely to be ordered in the near future. They are all to be cargo steamers of about 7000 tons deadweight carrying capacity on a light draught. They will be coal burners with triple-expansion steam engines, and will be designed to steam at 11 knots on 21·5 tons of coal per day, or at 10 knots on 16 tons, and at 9 knots on 12 tons per day. During the week the Furness Shipbuilding Company, Ltd., also obtained orders for two motor-ships of 9000 tons deadweight carrying capacity for Sir William Reardon Smith and Sons, Ltd., of Cardiff. The engines will be built by William Doxford and Son, Ltd., and will have opposed pistons 23·6in. in diameter and will develop about 3200 B.H.P.

Building Industries National Council.

THE Building Industries National Council, which came into being, as a constitutional body, yesterday, Thursday, February 9th, is the first of its kind in this country to secure the co-operation of masters and operatives, professional men and technical men. The objects of the Council are to provide a medium for common effort on the part of appropriate organisations which is likely to conduce to the welfare of the industries generally, and as a whole for maintaining the industry as an efficient unit in the economic structure of the country capable of providing employment and a means of livelihood for a substantial part of the population. The preliminary steps, it will be remembered, were taken in August, 1932, when Sir Raymond Unwin, President of the R.I.B.A., called a conference of all representative organisations interested in building construction with a view to forming a central body which would attempt to counteract the damaging effect upon the industry of the economy wave, and, in preparation for the future, would serve as a centre of co-ordination and co-operation for the maintenance and furtherance not only of its own prosperity, but of the prosperity of the nation by maintaining and constantly improving its high standards in technique and materials. The new Council wishes to make more widely known the function of the building industries in the economic life of the country and to play its part in the great reconstruction of the industrial and municipal life of the nation.

Railway Wages.

AT the end of last week the railway companies made their rejoinder to the decision of the railway trade unions—recorded in a Journal note of January 27th—not to accept the findings of Sir Harold Morris, the independent chairman of the National Wages Board. In a letter which has been sent to each union, the companies express regret that the three unions are not prepared to accept the chairman's findings. The letter further points out that the railway companies have acted in conformity with what they believe to be the intention of the constitution and the procedure of the National Wages Board. Their application to the Board having led to a finding by the independent chairman which the unions decline to accept, and the railway companies having, in their judgment, fulfilled the obligations placed upon them by the Act which constituted the National Wages Board, they must now proceed, the letter states, to consider afresh the situation thus presented. The letter gives no indication of future policy, and it does not appear as yet what the next step will be. A booklet reviewing the whole position of the railways, and entitled "The Case of the Four Group Railway Companies for a Reduction in Railway Labour Costs," has just been issued by the Railways Staff Conference, 35, Parliament-street, S.W. 1.

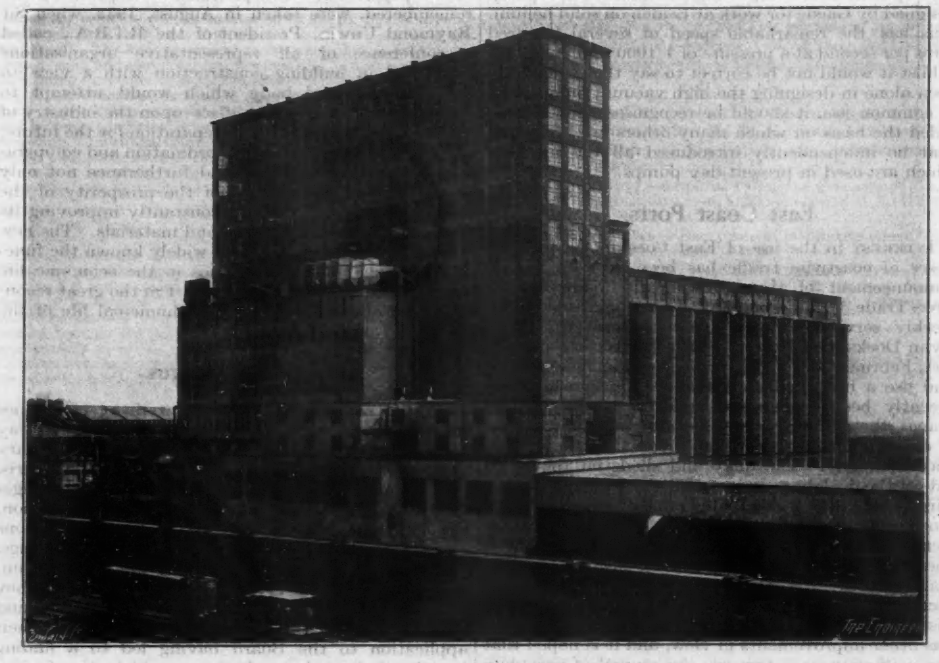
New Admiralty Orders.

THE Admiralty announces that it has decided to entrust the contracts for the cruisers, flotilla leader, destroyers, and sloops of the 1932 naval programme to the firms mentioned below. The contracts will be placed shortly. The cruiser "Galatea" will be built and engined by Scotts Shipbuilding and Engineering Company, Ltd., of Greenock, and the "Phæton" will be constructed by Swan, Hunter and Wigham Richardson and Co. Ltd., and be engined by the Wallsend Slipway Company, Ltd. Beardmore and Co., Ltd., of Dalmuir, will build the machinery for the cruiser "Apollo," which is to be constructed at Devonport Dockyard. The order for the flotilla leader "Faulknor" will be placed with Yarrow and Co., Ltd., of Scotstoun, where the hull and machinery will be built. Of the eight "Fearless" class destroyers, two will be built and engined at each of the yards of J. S. Samuel White and Co., Ltd., of Cowes; Cammell Laird and Co., Ltd., of Birkenhead, and John Brown, Ltd., of Clydebank, while the hulls for two further destroyers will be constructed by Vickers Armstrongs, Ltd., the machinery being supplied for these two ships by the Parsons Marine Steam Turbine Company, Ltd. The two sloops "Harrier" and "Hussar" will be built and engined by John I. Thornycroft, Ltd., of Southampton.

L'Atlantique Fire.

AT the request of Captain Schoofs, the commander of "L'Atlantique," the ship was, on Monday last, February 6th, condemned by the Cherbourg Tribune of Commerce, which stated that she was no longer fit for navigation. The expert examination of the hull has revealed considerable distortion of the plating and frames, but until the ship is dry-docked the real extent of the damage will be unknown. It is now understood that Mâitre Leopold Dòr, the legal adviser of the Compagnie Sud Atlantique, the owners, will inform the insurance companies of the Tribunal's decision and will notify them that the company will hand over the wreck to the underwriters. Should the insurance companies disagree with the decision made, they will have the right to appoint new experts to inquire into the matter and present a case before the Tribunal of Commerce of the Seine. Meanwhile the President of the Committee which was appointed to inquire into the disaster has, on the presumption that the outbreak of fire was caused by foul play, lodged a complaint with the judicial authorities at Bordeaux. It is expected that the case will now be legally investigated. The Committee, it is understood, has reached a unanimous opinion that there are good grounds for setting aside possible causes of the outbreak other than foul play.

GRAIN ELEVATOR, BALTIMORE AND OHIO R.R.



Moving Forms for Concrete Construction

By H. H. BROUGHTON.

IN a paper presented before the Institution of Mechanical Engineers on January 27th, the author described a method of constructing reinforced concrete silos and silo buildings by means of movable shuttering or "moving forms," as they are called.* As regards speed and economy of construction, and quality of workmanship, the method is an unrivalled one for buildings of a certain well-defined type, and it is thought that some examples and illustrations may be of interest to those contemplating the construction of such buildings. Although the examples about to be described are restricted to grain elevators and silos, the method has been applied with conspicuous success to storage bins of all kinds as well as to quay walls, and its application to the cores of dams is under consideration.

The elementary principle of the method is merely that of pouring concrete into a shallow mould of the same size, in plan, as the building it is desired to construct and, as the concrete takes its initial set, slowly and continuously moving the mould vertically upwards till the required elevation is reached. Tubular screw jacks secured to inverted U-shaped yokes rigidly attached to the forms, are used for lifting purposes and the entire weight of the forms is carried by steel jack rods set vertically and embedded in the concrete walls as pouring proceeds. As a rule the jacks are manually operated, but, if desired, they may be motor operated by means of line shafts. In most cases, however, manual operation suffices. Buildings covering an acre or more and 100ft. to 200ft. in height are constructed in this manner with moving forms 4ft. in depth and the walls, columns, and floor beams are virtually monolithic.

A sectional plan of a typical silo building intended for the storage of grain is shown in Fig. 1. There are thirty-eight main bins or tanks, arranged 4 by 10 and pitched at 26ft. 8in. centres apart, two of the bins being omitted to provide accommodation for a railway track. Each has an inside diameter of 26ft. and a height of 90ft., and the thickness of the walls is 7in. In addition to the main bins there are twenty-six interspace bins, certain of which are subdivided so as to provide economical storage for small parcels of grain. The moving forms during various stages of construction are well shown by the four views, Figs. I. to IV. in the Supplement. The details are so clearly depicted as to render lengthy description unnecessary. Fig. 2 herewith illustrates the construction of the moulds to form the outer walls, the bins, and the interspaces, but neither the yokes nor the jacks are shown. Moreover, at the time the photograph was taken the pouring floor had not been laid on the top of the forms. In Fig. 3, however, many of the yokes and jacks are shown in position. A view of the forms with the floor in course of construction is given in Fig. II. in the Supplement. In this illustration will be noticed two I beams extending the full length of each row of tanks. These beams, which are built in when the forms are being assembled at ground level, are carried up with the forms until the roof is reached, when they become the permanent roof beams in the finished structure. This is a convenient and practical method of placing roof (or bin floor) beams. The forms nearing completion and fully completed are illustrated in Figs. III. and IV. respectively.

Progress photographs of the actual building are reproduced in Figs. V. to VIII. The photograph reproduced in Fig. V. was taken on the day that pouring began, and it will be perceived that the forms have been jacked about 2ft. above the foundation mattress. The wall is clearly discernible below the forms. Two days later the photograph, reproduced

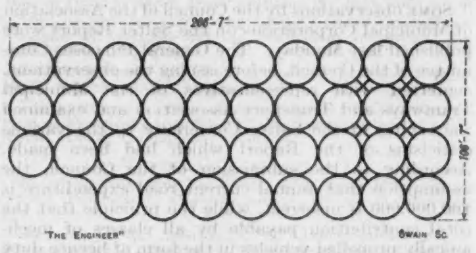


FIG. 1—PLAN OF TYPICAL SILO

in Fig. VI., was taken. As quickly as the green concrete wall is exposed below the forms it is rubbed smooth, the men engaged on the work standing on a platform which depends from and is carried up with the forms. The boxed metal casements shown in Fig. VII. were inserted in the forms at the correct elevation and the concrete was poured round them.

FIG. 2—FORMS READY FOR YOKES, JACKS AND FLOOR

The building nearing completion—elevation 115ft.—is shown in Fig. VIII. The quantity of concrete poured in the fifteen days during which the forms were in motion amounted to 9250 cubic yards. Two ten-hour shifts per day were worked by the steel and concrete crews and the jacking was practically continuous throughout the period. The actual vertical movement of the forms per lift depends on a number of factors and varies from ¼in. to ½in. When the forms have been jacked to the maximum elevation they are secured temporarily to the walls and the yokes and jacks are removed. The floor of the forms is then used as fixed shuttering for the roof slab.

Figs. 4, 5, and 6, reproduced from photographs taken at six-day intervals, illustrate a smaller silo storage than that just described. In this case only

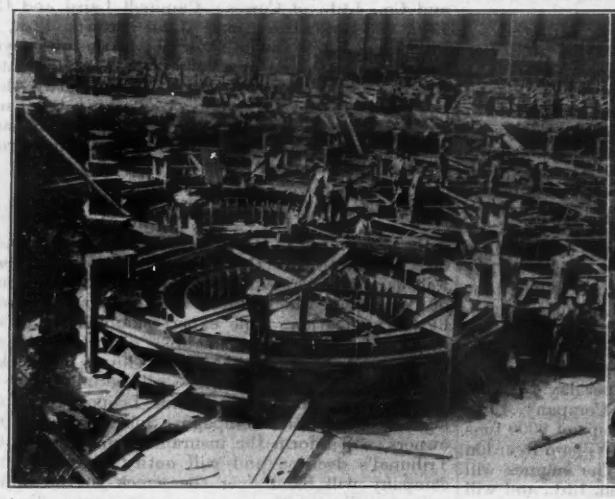


FIG. 3—FORMS WITH YOKES AND JACKS IN POSITION

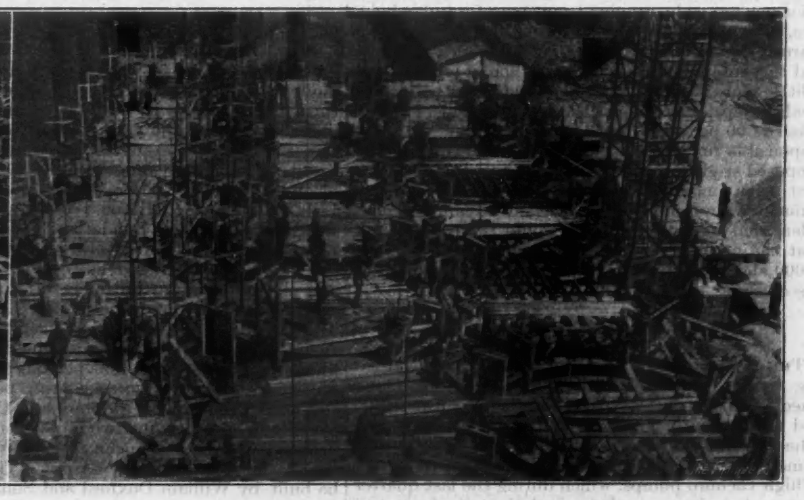


FIG. 4—MOVING FORMS IN COURSE OF CONSTRUCTION

* The concluding portion of this paper, containing additional information concerning the nature and use of moving forms, will be found reprinted elsewhere in this issue.—ED. THE E.

the tanks were poured by means of moving forms, the basement and cupola being constructed by means of fixed shuttering.

The guyed hoist towers seen in several of the illustrations are fitted with single or duplex skip hoists for elevating the concrete in batches from the mixer to a side hopper above the pouring floor. This hopper discharges into tip carts by means of which the concrete is distributed. The hoist tower is also furnished with a man hoist and, or alternatively, with a staircase to give easy access to the forms. A jib crane, secured to the side of the tower, is provided for hoisting the reinforcing steel and other material. Flood-lighting is used to illuminate the forms at night.

In most cases the arrangement of the mixer plant is influenced by local conditions; but, in view of the speed of construction, a good lay-out is essential. Ample storage facilities both for cement and aggregate are requisite, and provision has to be made for the storage of a large tonnage of reinforcing steel. As a rule it is advisable to provide two mixers, one being usually a standby.

The application of moving forms to reinforced concrete structures is not restricted to simple circular work, as will be seen from Figs. IX. to XV. in the Supplement. This complicated building, measuring 115ft. by 100ft. in plan, was poured from ground-floor level to a height of 187ft. in twenty-nine and a-half days, during which time 7740 cubic yards of concrete and upwards of 950 tons of steel reinforcing were placed. The average rate of rise was 6ft. 4in. per day, and on several days the rate exceeded 8ft. per day. In passing it may be noted that the rate of progress is governed by a number of factors, amongst which may be mentioned the character of the work, the quantity of concrete per foot, and climatic conditions. Under specially favourable conditions higher rates than those given above can be achieved. Since the forms are 4ft. deep it will be noted that if the pouring rate is 5ft. per day the concrete remains in the forms $4 \times 24 \div 5 = 19 \cdot 2$ hours before it is exposed.

The ground-floor storey of the building, illustrated in Fig. XV., consists of a large number of massive columns and outside curtain walls. The columns, which are pitched at 20ft. by 16ft. centres, are 49in. octagonal section and contain 4 per cent. of vertical steel and 1 per cent. of spiral reinforcing. A view of the reinforcing for one of these columns is given in Fig. XIII. The 155 rectangular bins supported by the columns are 67ft. deep and above them are the several storeys for the garnering, weighing, and distribution of the grain and for housing the machinery associated with these operations. With the exception of the floor slabs the entire building above the ground-floor slab was constructed by means of moving forms. Reference to Figs. XIV. and XV. will show that at three elevations the plan of the building is altered. At each cut-off a section of the forms is cut adrift, the outer walls of the active forms are reconditioned by the carpenters, and the floor of every cut-off section serves as fixed shuttering for the roof slabs. The ease with which window, door, and other openings can be provided will be inferred from the illustrations.

The engraving at the head of page 134 furnishes a good example of reinforced concrete building construction by means of moving forms. The drier house at the extreme left, the whole of the working house above the first storey, and the storage bins on the right were built in this manner. The buildings depicted in Figs. VIII. and XV. were constructed under the author's supervision, and those shown in Fig. 6 and at the head of page 134 were constructed to the designs and specifications of the Metcalf Company, of Montreal, with whom the author is associated.

FIG. 5—POURING IN PROGRESS

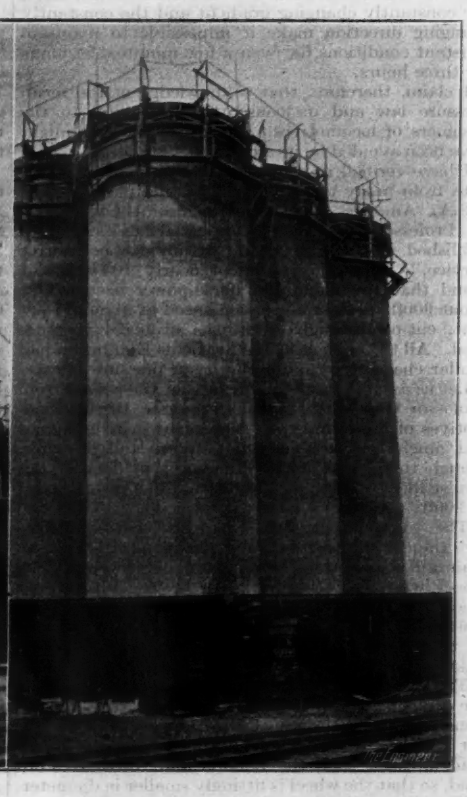


FIG. 6—FINISHED BUILDING

Optimum Diameter of Driving Wheels.

By W. E. DALBY, F.R.S.

IT has been said that the small driving wheels of the bogies under electric trains do more damage to the permanent way than the larger driving wheels of steam locomotives, notwithstanding the variation of rail pressure caused by the balance weights.

If this be true, it follows that an increase in the diameter of the driving wheel should result in a decrease of damage to the permanent way. The history of the locomotive, however, shows an opposite tendency in design. The table on this page shows the driving wheel diameters of a few well-known and successful locomotives of their day, roughly in historical order.

All these engines were designed for express traffic. The list shows that with progress of time and increase of load the diameter of the driving wheel has steadily decreased.

Neither for electric trains nor for steam locomotives is the size of the driving wheel settled primarily with reference to the damage it is likely to do to the permanent way. It is settled in relation to the way the power is produced to drive it.

Driving Wheel Diameters.

Diameter of driving wheel.	Railway.	Type.
9ft. 0in.	Bristol and Exeter	4–2–4
8ft. 6in.	"Cornwall," L. and N.W.	2–2–2
8ft. 0in.	Great Northern Railway	4–2–2
8ft. 0in.	"Lord of the Isles," G.W.R.	(2–2)–2–2
7ft. 7½in.	"Lady of the Lake," L.N.W.	2–2–2
7ft. 6in.	N.E.R.	4–2–2
7ft. 0in.	M.R.	4–4–0
6ft. 6in.	L.N.W. and many others	2–4–0
6ft. 0in.	Experiments, L.N.W. and many others	4–6–0

The motor driving electric stock is a high-speed machine, and has usually to be geared down to the axle. There is therefore a tendency to use small wheels. There is no apparent reason why these small wheels should not turn very fast, because there is no variation of rail load as in a locomotive. In the Berlin–Zossen Railway tests they did turn very fast. The car was carried on two six-wheeled bogies and weighed 92 tons. The highest speeds were over 112 miles per hour. The diameter of the bogie driving wheels was 49½in. = 4·1ft. The wheels thus ran at 770 revolutions per minute, or 12·8 revolutions per second. The driving wheels of a locomotive may approach, but they rarely exceed, 6 revolutions per second. Increase in the size of the driving wheel would not appear to be necessary in the light of these experiments, since no electric trains approach speeds of 112 miles per hour. The track was specially prepared for the Zossen trials, for damage to the road depends upon the maintenance of the road itself.

The steam producing the power in a locomotive has increasing difficulty in getting into the cylinder as the piston speed increases. Other conditions being the same, the weight of steam which gets shut in the cylinder at cut-off diminishes as the speed increases. The diameter of the driving wheel should be determined by these characteristics of the locomotive. The question of damage to the permanent way is only considered by the locomotive designer in so far that he must make his design conform with axle loads specified by the civil engineer of the line.

Let us now examine the suggestion that a small wheel does more damage to the track than a large one.

About twenty years ago I experimented with a model pair of wheels running down a slightly inclined model track. The wheels, rigidly connected by the axle, had no flanges and were wider on the treads than the scale width. The treads were coned to the regulation 1 in 20. The heads of the rails were rounded to scale, and set at 1 in 20 also. No matter how carefully the wheels were started, they ran down the track with a sideways oscillation, somewhat like a ship at sea rolling as she steams ahead. Model pairs of larger diameters had longer periodic times of oscillation. This free motion down the track would cause little wear, because it was pure rolling. Now let the model have flanges. The smooth oscillation of the former experiment is changed to an intermittent oscillation by the transient flange contacts from side to side, as the wheels run down. The smooth curve, representing the oscillation of the flangeless wheels, is changed to a similar curve, but with the peaks cut off. Here we find a definite cause of wear, for when a flange makes contact with a rail there are differential velocities, and therefore frictional rubbing and loss of power.

To go from the laboratory to the road, when two pairs of wheels are mounted in a bogie truck conditions of constraint are added which materially alter the problem. Now the axles are compelled to keep parallel. The constraints and conicity compel the wheels of an axle to roll on unequal diameters, and there is therefore friction at the treads. The flanges are brought into transient contact with the rails at every lateral oscillation and there is also friction at the flanges. Elsewhere I have estimated that continuous flange contact with a rail causes twenty times the frictional resistance that is caused by the slip on unequal diameters which goes with the flange action.

Instead of the perfect conditions of the model track, there are the imperfect conditions of the real track. Slight differences in level of the rails, slight differences in the packing up of the sleepers, slight variations in the gauge, the rail joints are amongst the imperfections of the most perfectly maintained track. Moreover, the wear of the rails and the wear of the tires modify the perfect conicity of 1 in 20.

These causes combined make it unlikely that the type of oscillation associated with the motion of a pair of free wheels is ever produced, but the tendency is there, and in certain conditions it may be produced in a suppressed form. The oscillations of the bogie as a whole are of a different type. The free lateral oscillations of a bogie depend on the moment of inertia of the bogie about a vertical axis through its centre of mass and a couple about the same axis. A couple is brought into action every time a flange makes contact with the rail as the bogie runs along the imperfect track. A flange contact is like the transient application of the brake to one wheel. The flange force at the tread of the wheel transferred to the mass centre of the bogie forms a couple which tends to turn the bogie about its centre of mass. Any imperfection in the track starts the bogie oscillating. These oscillations are accompanied by transient flange friction, slip at the treads due to conicity and the constraints, and therefore frictional loss of power and damage to the road. As a general rule, increase in the size of the wheels increases the moment of inertia of the bogie and therefore reduces the number of flange contacts per mile. From this point of view, therefore, increase in the wheel diameter would seem to be advantageous.

The load carried by the wheel deflects the rail and deflects the tire and there results an area of contact at the tread which is smaller the smaller the diameter of the tire. The intensity of stress is thus reduced as the diameter of the tire is increased. There are no available data as to how this intensity of stress and the elastic deformation which it causes

vary with the diameter of the tire. The question wants thoroughly investigating. But we may conclude that under equal loading a small wheel will do more damage to the track than a large one, especially if the loading is heavy.

There is also the precessional couple which appears when the axle tries to change its direction. It is acting all the time that the bogie is oscillating. But unless the wheels are very small and are turning very fast precession is negligible.

Thus, many causes contribute to the wear of the road, but in the light of the Berlin-Zossen experiments there is no optimum diameter for the wheels of the bogies of electric stock.

Providing that the loading of the wheel produced only elastic deformations well within the true limit of elasticity of the rails, and the wheel base of the bogies is long enough and that the track is well maintained, small wheels may be run up to high speeds with little damage to the track or to themselves.

STEAM LOCOMOTIVE DRIVING WHEELS.

We are on different ground with the locomotive. Here there is an optimum diameter, as I proceed to show.

The weight of steam shut in the cylinder at cut-off depends on the piston speed and the design of the ports and passages, with given conditions of regulator opening and cut-off. Keeping the conditions unchanged, an alteration in the design changes the weight and an increase of piston speed reduces the weight.

The mean pressure developed by this falling weight of steam gets less and less as the piston speed increases. I discovered by plotting the results of Professor Goss' experiments on "Schenectady No. 1," carried out on the testing plant installed at Purdue University, U.S.A., that the mean pressure may be expressed with negligible error between the piston speeds of 300ft. and 1200ft. per minute with constant regulator opening and given cut-off by

$$p = c - b\,s,$$

where p = the mean pressure in pounds per square inch;

c = a constant depending on mean pressure at very slow speed;

b = a constant depending on the design;

s = the piston speed in feet per minute.

It follows that the horse-power for these conditions can be calculated from

I.H.P. per cylinder

$$= \frac{(c - b\,s)\,l \cdot a \cdot n}{33{,}000} = \frac{(c - b\,s)\,a \cdot s}{33{,}000} = \frac{a\,(c\,s - b\,s^2)}{33{,}000}$$

a = area of cylinder in square inches.

l = stroke in feet.

n = strokes per minute.

The form on the right shows that the I.H.P. is a maximum when s, the piston speed, is equal to $c/2\,b$, and the value of the maximum

$$\text{Maximum I.H.P. per cylinder} = \frac{c^2\,a}{132{,}000\,b}$$

A test on "Schenectady No. 2," made by Professor Goss with boiler pressure 220 lb. per square inch, cylinders 16in. by 24in., regulator wide open and cut-off about 14 per cent. of the stroke, gave $c = 68$ and $b = 0{\cdot}038$. Therefore

Piston speed for maximum power

$$= c/2\,b = 68/0{\cdot}076 = 900\text{ft. per minute.}$$

Maximum I.H.P.

$$= \frac{68^2 \times 201}{13{,}200 \times 0{\cdot}038} = 185 \text{ I.H.P. per cylinder.}$$

There were two cylinders, so that the total I.H.P. was 370. Of this 16⅓ per cent. was absorbed in engine friction, leaving 309 I.H.P. to drive the train.

With these data the diameter of the best wheel for a given service and, in addition, the greatest load which can be hauled can be closely estimated.

Suppose the service demanded from the engine is to run for long stretches on the level at 40 m.p.h. hauling the as yet unknown load. The stroke is 2ft., so that the crank must turn at 225 revolutions per minute = 3·75 revolutions per second, to maintain the piston speed of 900ft. per minute. Thus, the driving wheel must make 3·75 revolutions per second to drive the train at 40 m.p.h. It must, therefore, be 5ft. in diameter neglecting slip.

Let us go on to estimate the load which the engine could haul at 40 m.p.h. on the level.

There is 309 I.H.P. available for driving the whole train.

The engine weighs 48·7 tons in all. Reckoning the engine resistance to be 20 lb. per ton at 40 m.p.h., it would absorb

$$\frac{48{\cdot}7 \times 20 \times 58{\cdot}6}{550} \text{ I.H.P.} = 103 \text{ I.H.P.,}$$

to drive the engine alone at this speed.

There is thus available at the engine draw-bar for hauling 309 − 103 = 206 I.H.P.

The corresponding draw-bar pull at 40 m.p.h. is 1930 lb. Reckoning the resistance of the vehicles, including the tender, to be 10 lb. per ton, the load hauled is 193 tons.

The tractive force at the driving wheels to haul 193 tons and drive the engine at 40 m.p.h. would be that corresponding to 309 I.H.P.—that is 2900 lb. = 1·3 tons. This wants an effective axle load of 6·5 tons to produce it. I say effective, because the weighbridge loads are alternately increased and diminished by the dynamic loads due to the balance weights.

But the full investigation of this question would take us too far afield. Suffice it to say that this was a four-coupled engine with 27 tons on the coupled wheels available for producing adhesion. This would be ample for the greater draw-bar pulls and lower speeds associated with later cut-offs.

This example has been worked out fairly fully in order to show how vital are the data which can be obtained from a fixed testing plant. For the constants b and c can only be found from a fixed testing plant. A series of tests of at least three hours each must be made under constant load to find them, and where can such a series be made on the road? On the road the constantly changing gradient and the constantly changing direction make it impossible to maintain constant conditions for even a few minutes, let alone for three hours.

I claim, therefore, that a knowledge of the mean pressure law and its consequences is vital to the designers of locomotives. Many past failures might have been avoided by its aid.

I have verified its truth by the examination of the data from many tests, all from testing plants in the U.S.A. Amongst these I may mention the test made by Professor Goss on "Schenectady No. 2," and published in "High-pressure Steam in Locomotive Service." From the results of nearly 100 trials, I found that the maximum horse-power occurred at about 900ft. per minute piston speed at about 14 per cent. cut-off through all ranges of boiler pressure used. All the engines at the St. Louis Exhibition had similar characteristics for the mean pressure lines.

Let us assume for the moment that the results from Professor Goss' testing plant apply to British locomotives of an early type. The early British engines had much the same design of ports and passages, though there were many differences in detail. Let us test their performance in relation to a piston speed of 900ft. per minute = 15ft. per second.

The "Lord of the Isles" had 2ft. stroke. Therefore the driving wheel turned 3¾ times per second to maintain a piston speed of 900ft. per second. The wheel was 8ft. diameter. At 3¾ revolutions per second the wheel drove the train at 94ft. per second = 64 m.p.h. I cannot work out the probable load at this speed, because the constants c and b are unknown.

The "Lady of the Lake" had a 2ft. stroke, and the driving wheel was 7·6ft. diameter. At 3¾ revolutions per second the wheel drove the train at 89·6ft. per second = 61 miles per hour. The Great Western road is easier than the London and North-Western road, so that the wheel is fittingly smaller in diameter.

The Great Northern Railway 8ft. single express passenger engine of bygone fame had a 28in. stroke = 2·33ft. Therefore the driving axle turned 3¼ times per second to maintain a piston speed of 900ft. per minute. At 3¼ revolutions per second the 8ft. wheel drove the train at 82ft. per second = 56 m.p.h. The road is heavy to Potters Bar, and this is reflected in the lower speed.

The 6ft. 6in. coupled engine designed by Ramsbottom for the London and North-Western Railway had a very free exhaust. The ports were formed in surfaces inclined to one another at about 60 deg. just at the base of the exhaust pipe, so that the exhaust steam had an unusually easy outlet. This resulted in a less sloping mean pressure line, that is, a lower value of b. The best piston speed may therefore be guessed at 1000ft. per minute = 16·7ft. per second. The stroke was 2ft., so that the driving wheel turned 4·2 times per second to maintain the piston speed of 1000ft. per minute. At 4·2 revolutions per second the wheel drove the train at 85ft. per second = 58 m.p.h.

Later, a six-coupled engine was built at Crewe, with wheels 6ft. in diameter and two cylinders, 26in. stroke, to replace the "Experiment" class of compounds. The Ramsbottom device for getting a free exhaust was not included in the design. I guess, therefore, that the constant b was rather higher in value than in the 6ft. 6in. type, and that the mean pressure line sloped down rather more, making it reasonable to guess the piston speed for maximum power at 870ft. per minute = 14·5 ft. per second. The driving wheel would have to turn at 3·6 revolutions per second to maintain the piston speed of 14·5ft. per second. At 3·6 revolutions per second the 6ft. wheel would drive the train at 68ft. per second = 46 m.p.h. An engine of this class was sent to the Great Western Railway Company to run their Riviera Express. This express runs non-stop from Paddington to Plymouth at about 52 m.p.h. The lent engine did not do very well on the job; in fact, it had to come off at Exeter. This is past history, but it shows what errors we could avoid if we knew the constants c and b.

The modern locomotive has long stroke piston-valves and the old values of c and b are changed. Guessing the piston speed of the Great Western six-couples, 68in. wheeled engine, 26in. stroke, to be 1500ft. per minute for maximum power, the driving wheels must turn 5·8 times per second. At 5·8 revolutions per second the wheels will drive the train at 83 m.p.h.

Why go on guessing? Why not establish a locomotive testing plant of our own in these islands? As long ago as 1911 I discussed the matter with Lord Stalbridge, then chairman of the London and North-Western Railway Company, and proposed that a testing plant should be established and run for the common benefit of all the railways by the Imperial College of Science and Technology. Lord Stalbridge was favourable, but railway trouble and then the war prevented anything being done. After the war I raised the matter again in an address I gave to the Locomotive Engineers of Glasgow in 1923. Mr. Gresley publicly advocated a testing plant, and at last the Locomotive Experimental Station Committee of Inquiry was appointed by the Lord President of the Council in 1928, under the chairmanship of Sir Alfred Ewing, to go into the matter of its establishment under the auspices of the Department of Scientific and Industrial Research, with the co-operation of the railway companies, the locomotive manufacturing industry, and locomotive consulting engineers.

Mr. Tizard was secretary of the Department at the time the Committee was appointed. I had the honour to be included in the Committee, and later was elected Chairman of the Sub-committee set up to consider in detail the design and cost of the plant. The Sub-committee included Mr. Collett, Sir Henry Fowler, Mr. Gresley, Mr. Goodall, and Mr. Whalley. We found a site, agreed on the design of plant and buildings, and estimated the cost, and reported to the main Committee. They accepted our findings and included them in the final report to the President of the Council, dated June 27th, 1930. And there at present it rests in peace. If the men directing the finances of our railway companies realised what savings would result from such a plant, their share of the money would be forthcoming at once.

On November 18th I listened to a speech by the Lord President of the Council, Mr. Stanley Baldwin, at the National Physical Laboratory, on the occasion of the opening of the second tank for just the sort of researches about ships as are wanted about locomotives. The Lord President dwelt on the value of the work done in the old tank started by Sir Alfred Yarrow in 1911; on the continual growth of the work, on the increasing need for a new tank, and on the pressing necessity for continued research if we are to maintain our premier position in the shipbuilding of the world. He declared the tank open, and then took the first ride on the carriage which spans the waterway.

I wonder how long it will be before we attend a similar ceremony and listen to a similar speech at the opening of the first Locomotive Testing Plant in the first National Railway Laboratory yet to be built in these islands.

The New Dunston Power Station.

No. I.

THE new 50-cycle Dunston power station of the North-Eastern Electric Supply Company marks the first important step towards the supply of electrical energy throughout the company's area at standard frequency. Compared with the two new stations at Battersea and Barking, Dunston has been designed on rather more elaborate lines, for apart from the fact that reheating has been adopted, one of the boiler houses has been equipped for pulverised coal firing. Hence the operating results of the three stations will arouse considerable interest. The steam pressure at the turbine stop valves is 600 lb. per square inch, and the temperature 800 deg. Fah., so that on the whole the design of the Dunston station may be said to be well up to date.

THE BUILDINGS.

Situated on the south bank of the river Tyne, about 2 miles west of Newcastle, the site has an area of approximately 75 acres, with a river frontage of about a quarter of a mile, and offers the important advantages of proximity to the centre of gravity of the load and access to cheap fuel. Ultimately, the station will contain six 50,000 kilowatt sets, but only three machines have so far been installed in the present building, which is capable of accommodating a fourth set, as indicated in the plan, Fig. 2. There are two independent boiler houses, one containing eight stoker-fired boilers and the other four pulverised fuel fired boilers, which have been provided to use small surplus coal in order to co-operate with the collieries which depend in a large measure on the company for the supply of power used in the pits.

The turbine, boiler, and switch houses are all of the steel-frame type, but in place of the usual brick panels, glazing has been used to a very large extent,

with the result that the natural illumination of the entire station is exceptionally good, notwithstanding the absence of roof lighting. The contractors for the

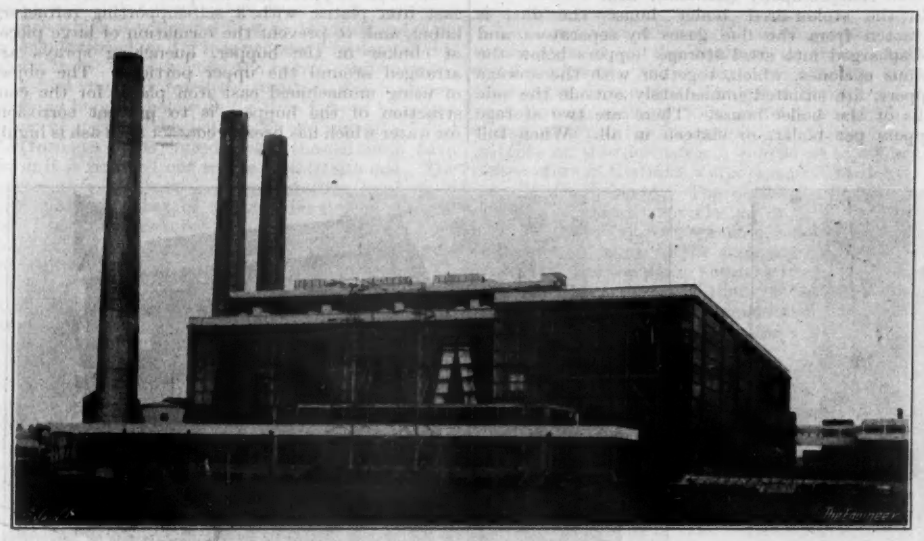


FIG. 1—EXTERIOR VIEW OF NEW DUNSTON STATION

civil engineering were Sir Robert McAlpine and Sons, with Tileman and Co. acting as sub-contractors for the ferro-concrete chimneys. Dorman Long and Co. were responsible for the steel-frame construction, and Heywood and Co. for the glazing, the glass itself being supplied by Pilkington and Co., Ltd. The roof of the turbine house is flat, and in order to obviate condensation on the underside it is of hollow construction, the outer side being covered with Barrett covering and Tentest insulating boards. Two cranes, manufactured by Joseph Booth and Brothers, with lifting capacities of 25 and 120 tons, and situated one above the other, serve the main turbine room, whilst a 12-ton crane of the same make is provided in the auxiliary annexe bay of this section of the station.

COAL-HANDLING PLANT.

The station—see Figs. 1 and 2—has been erected between the lines of the London and North-Eastern Railway and the river, and the part of the site which lies to the south side of the railway lines, covering an area of about 34 acres, serves as an emergency coal store, capable of storing approximately 16,000 tons of coal to a depth of 8ft. Coal is brought to the site in railway wagons, and is discharged into receiving hoppers below ground level at the north end of each boiler house, and is fed from these hoppers into gravity bucket conveyors by means of jigging feeders and rotary fillers, each conveyor having a handling capacity of 75 tons per hour, so that in a shift of eight hours the two conveyors can meet the requirements of one boiler house operating under maximum steaming conditions for twenty-four hours. At

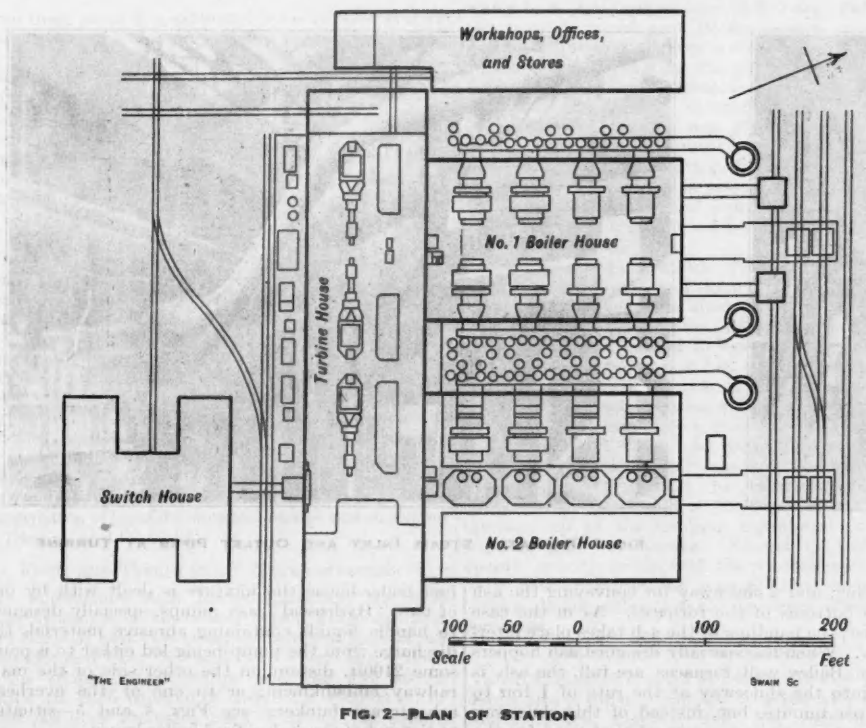


FIG. 2—PLAN OF STATION

positions immediately after the filler pits weighing machines are provided on the conveyors, for weighing the loaded and empty strands of the conveyor chain, so that the net weight of the coal passing to the bunkers is obtained. As the wagons used by the London and North-Eastern Railway for coal traffic are of the bottom discharge type, no special arrangements have been made for emptying them into the receiving hoppers of the stoker-fired boiler house. But in the case of the pulverised fuel boiler house an enclosed wagon tippler, manufactured by Strachan and Henshaw, is provided to deal with the special wagons containing fine coal. The coal-handling plant was supplied by the Birtley Company, of Birtley, Co. Durham.

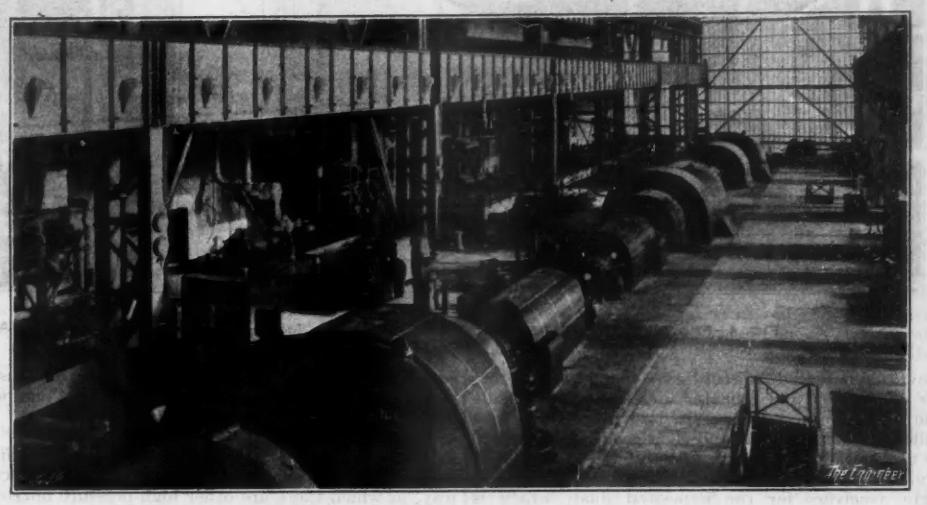


FIG. 3—TURBINE ROOM

As shown in the plan, the two boiler houses are arranged at right angles to the turbine-room. When generating plant has been installed to the extent of 300,000 kW, a third boiler house will be provided, and each will contain four boiler units and four reheater units.

THE BOILER PLANT.

As indicated in the plan, in one of the existing boiler houses there is a full complement of boiler and reheater plant—see Fig. 10 on page 144—whilst in the other (the pulverised fuel boiler house), there is only one line of boilers and reheaters. In each case the boiler and reheater plant is arranged in lines running at right angles to the longitudinal centre line of the turbine house, each line consisting of two reheater boilers (nearest the turbine house), and two ordinary boiler units. With this arrangement of boiler and reheater plant, there is a row of two re-heater units and two boiler units in a direct line, but at right angles to each turbo-alternator set, a scheme which gives a convenient and symmetrical lay-out. The contract for the Babcock type boiler plant was divided between Babcock and Wilcox and Clarke, Chapman, the former supplying the six reheater units and the latter the six boiler units, all the equipments in the stoker-fired boiler house being provided with Babcock and Wilcox stokers, tubular air heaters, Bailey water-cooled furnaces, and Foster grilled tube economisers.

All the pulverised fuel fired boilers have Babcock and Wilcox economisers and plate type air heaters. The reheater units supplied under the Babcock contract have Calumet powdered fuel burners, and the boiler units supplied under the Clarke Chapman contract Woodeson burners. Each boiler and reheater unit has two Clarke, Chapman "Resolutor" pulverisers—Fig. 8—each capable of dealing with 5 tons of coal per hour. Normally, coal drying is carried out by means of hot air derived from the air heaters, but it is also possible to draw hot gases from the bottom of the furnaces to supplement the supply from the air heaters. Each of the six boiler units is capable of producing and superheating to 825 deg. Fah. continuously 156,000 lb. of steam per hour at a pressure of 625 lb. per square inch, whilst each reheater unit, which consists of a low-pressure steam reheater, combined with a water-tube boiler, can produce and superheat 125,000 lb. of steam per hour at the same pressure and temperature, and is also capable of reheating approximately 180,000 lb. of steam per hour from a temperature of about 520 deg. to 825 deg. Fah. Under normal conditions the temperature of the reheated steam to the turbines will be automatically maintained at 825 deg. Fah.

With the exception of the various integral pipes associated with the turbines, condensers, boilers, &c., all the pipe work of the station was supplied under one contract awarded to Aiton and Co., of Derby, the contract also including the feed pumps, service pumps for softened water, fire service, reserve feed, test and sump pumps, air compressor, and water tanks. The high-pressure piping is of solid drawn steel, and the joints are of the Aiton "Corwel" sealed, welded type. The steam receivers—Fig. 6—consist of steel forgings, the valves at the receivers in the main supply pipes to the turbo-alternator being motor-operated and remote controlled. Expansion bends and loops are either of the Aiton corrugated or Aiton creased type. A general view of the reheated steam inlet and outlet pipes at one of the turbines is given in Fig. 7. All high-pressure valves were manufactured by Hopkinson and Co., Ltd., and the water service valves by J. Blakeborough and Sons, Ltd.

FORCED AND INDUCED DRAUGHT FANS.

The boiler and reheater units each have two forced draught and two induced draught fans made by Davidson and Co., Ltd. The forced draught fans

are situated in the boiler-house roof and draw their air supply from the inside of the boiler-house above the boilers. In the stoker-fired boiler-house the induced draught fans are at the firing floor level, whilst in the pulverised fuel-fired boiler-house they are at the basement level. The fans are driven by squirrel-cage motors, the speed being controlled by hydraulic variable-speed couplings made by the Hydraulic Coupling and Engineering Company, of Isleworth. The Davidson dust-extracting plant for removing the dust from the flue gas before it passes to the induced draught fans, consists of six

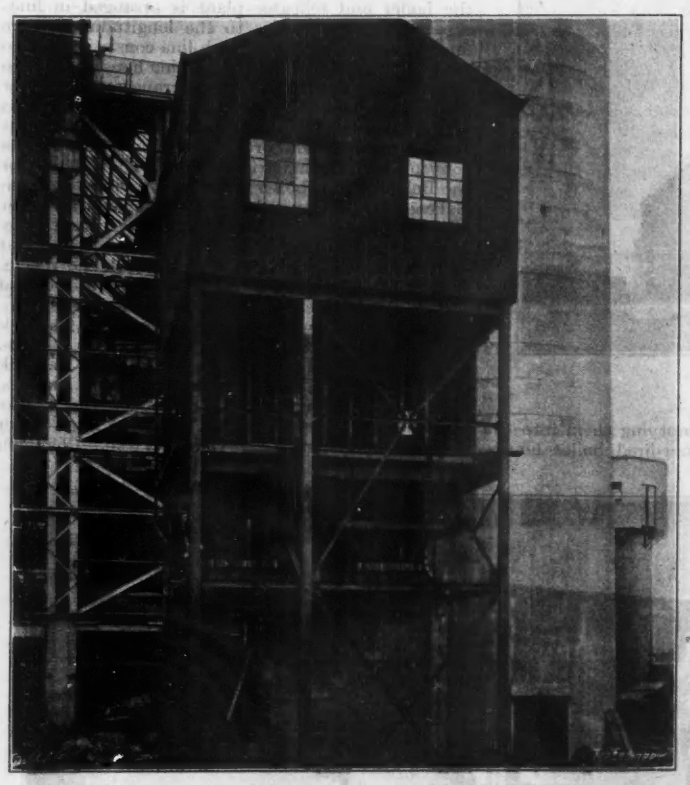


FIG. 4—FRONT VIEW OF ASH BUNKERS

FIG. 5—ASH BUNKERS AT END OF BOILER HOUSE

Davidson patented "direct" type flue dust collectors for each boiler and reheater unit, arranged outside the boiler-house buildings in two groups of three collectors per fan unit, and each group is connected to the suction side of its respective induced draught fan. At the bottom of the collectors there are air-tight receivers for the deposited dust, which is periodically removed by a suction plant.

ASH-HANDLING PLANT.

In the stoker-fired boiler-house the ashes are handled by a system of drag link scraper conveyors, made by the Underfeed Stoker Company, and working in a water trough which receives the ashes which fall from the rear of the chain grates. By means of two of these conveyors under each line of stoker-fired units, the ashes are conveyed and elevated to two overhead storage bunkers, Figs. 4 and 5, erected over a railway siding outside the north gable of the boiler-house. Under normal conditions one conveyor deals with the ash, whilst the other deals with the riddlings, which are kept separate from the ash in the divided ash bunkers and can be returned by trucks to the coal-receiving hoppers; but, in the case of emergency the riddlings conveyor can serve as the ash conveyor. The dust from the stoker-fired boiler house and the dust and ash from the pulverised fuel-fired boiler house are handled by "Hydrojet" plant, supplied by the Ash Company (London), Ltd.

In the stoker-fired boiler house the dust is extracted from the flue gases by separators, and is discharged into steel storage hoppers below the various cyclones, which, together with the storage hoppers, are situated immediately outside the side walls of the boiler house. There are two storage hoppers per boiler, or sixteen in all. When full each hopper holds approximately 7 tons of dust, which is sucked out by a water ejector with a number of high-pressure water jets.

After passing through the ejector the dust is intimately mixed with the water and the resulting slurry is discharged down sloping pipes into a sluiceway, in which there are other high-pressure nozzles. There are two longitudinal sluices which discharge into a third running across the end of the boiler house, and this sluice finally conveys the slurry to a sump at the end of the pulverised fuel boiler house in which there is a similar arrangement of dust collection and sluicing, and a sluiceway for conveying the ash from the bottoms of the furnaces. As in the case of the dust, the handling of the ash takes place intermittently. When the specially designed ash hoppers below the Bailey wall furnaces are full, the ash is fed out into the sluiceway at the rate of 1 ton to 1½ tons per minute, but, instead of this sluiceway having ejectors, as in the case of that used for the dust, a combination of sloping feed plate and high-pressure feed nozzle is used. The bottom of the ash hopper is in the form of an inclined feed plate, on which the ash rests, and at its lower end there is a feed nozzle which directs a high-pressure stream of water against the pile of ash and washes it down the feed plate and into the sluiceway, which cannot be clogged.

The ash hoppers are composed of unmachined, cast iron plates, with a self-supporting refractory lining, and, to prevent the formation of large pieces of clinker in the hopper, quenching sprays are arranged around the upper portions. The object of using unmachined cast iron plates for the construction of the hoppers is to prevent corrosion, for water which has been in contact with ash is highly corrosive. The sluiceways which convey the dust and ash to the sump are composed of half-round, nickel cast iron liners, set in a rectangular concrete trench covered by removable cast iron plates. As the liners are sprung into position, no bolts, wedges, or grouting in are necessary. Similarly, the cover plates are also self-fixing. At appropriate points along the sluiceways there are booster nozzles to boost the velocity of the water, and, with the pressure of water used, viz., 100 lb. per square inch, it has been possible to construct the sluiceways without a slope. On reaching the sump outside the end of the pulverised fuel boiler-house the mixture is dealt with by one of two "Hydroseal" ash pumps, specially designed to handle liquids containing abrasive material, the discharge from the pump being led either to a point some 2100ft. distant, on the other side of the main railway embankment, or to one of the overhead ash storage bunkers—see Figs. 4 and 5—situated at the end of the stoker-fired boiler-house.

In the first case the ash and dust are deposited over a large area, which will eventually be used as a coal store, whilst in the second case, after the water is drained off from the bunkers and returned to the

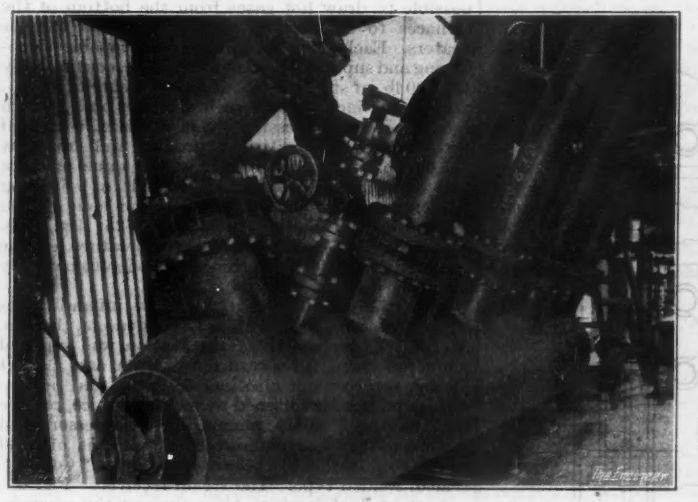


FIG. 6—STEAM RECEIVER

FIG. 7—REHEATED STEAM INLET AND OUTLET PIPES AT TURBINE

system for re-circulation, the ash is dumped in a dustless and commercially dry condition into railway wagons passing beneath the bunkers. One overhead ash bunker stands outside the building at the end of each row of stoker-fired boilers, from which it receives the ash which is conveyed to it by the drag link conveyor mentioned, and if it is necessary to deposit this ash on to the space beyond the railway embankment it is first dumped from the bunkers into concrete receiving hoppers below and is then fed out by a feed nozzle as used at the bottom of the pulverised fuel fired furnaces and is sluiced back to the ash sump, from which it is pumped out to the area mentioned. The construction of these overhead storage bunkers is very similar to that of the ash hoppers below the pulverised fuel-fired boilers, for they are built of unmachined cast iron plates held on a light steel framework.

The outlets at the bottoms of the bunkers are controlled by hand-operated horizontal cast iron gates, designed to prevent water dripping on to the railway trucks below, and in addition to these special water collecting gates louvres are provided for draining off the water. As will be gathered from Fig. 5, each bunker is composed of two parts, one for receiving the stoker ash and discharge from the ash pumps and the other the fine riddlings from the mechanical stokers, and although the riddlings are normally brought up by a drag link conveyor, they may also be dealt with by the ejector system which deals with the dust in the stoker-fired boiler-house. The major portion of the dust to be handled is that collected by the cyclone separators, but there are also parts in the boilers and below the air heaters and economisers where dust is deposited, and

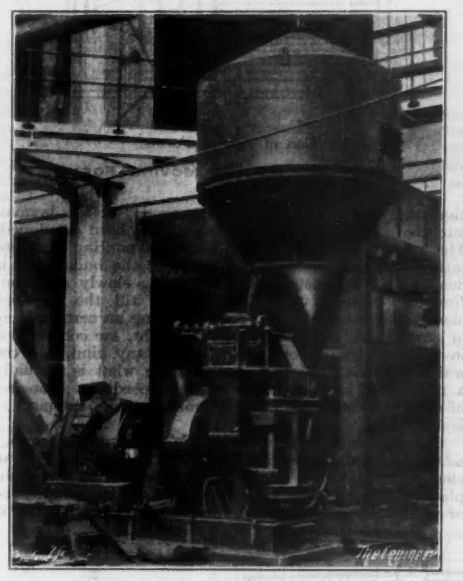


FIG. 8—"RESOLUTOR" PULVERISER

from these parts it is extracted by a vacuum system, the suction of which is produced by ejectors similar to those used on the cyclone collecting system and discharging into the sluiceways. High-pressure water required for the system is supplied by one of two vertical-spindle pumps designed to deal with abrasive-laden water and situated in the reservoir sump adjacent to the ash sump. The system comprises some thousand feet of sluiceway and approximately 1¾ miles of pipe work of various descriptions

CHIMNEYS.

There are three chimneys, one serving each line of boiler and reheater units, to which they are connected by a main waste gas flue situated alongside the boiler-house side wall at ground level. Each chimney is 250ft. high, measured from the ground, and is constructed of reinforced concrete lined on the inside with acid-resisting brick set in acid-resisting cement. The brickwork is arranged clear of the inner surface of the concrete shell and the annular space between is used for ventilation. Arrangements have been made for taking up the vertical expansion of the brickwork relative to the shell. At the bottom the diameter of each chimney is 18ft. and 15ft. at the top. The construction of the chimneys and linings was entrusted to Tileman and Co., Ltd.

FEED AND CIRCULATING WATER SYSTEMS.

In accordance with modern practice, the feed water system is of the closed type. There are four motor-driven and two steam-driven feed pumps, all manufactured by G. and J. Weir, Ltd. Two of the motor-driven pumps and the two steam pumps are each capable of delivering 480,000 lb. of water per hour against a head of 850 lb. per square inch, whilst the other two motor-driven pumps are designed for half that capacity. All the pumps are designed with a continuously falling characteristic curve from zero to maximum capacity, which ensures that the pumps will operate in parallel at all loads without hunting. The boiler feed make-up water is taken from the town main, but before it is delivered to the evaporators it is passed through a Kennicott water softener, in which it is reduced to 4 deg. of hardness in order to avoid scale forming on the evaporator coils.

The reinforced concrete circulating water pump house situated on the bank of the river supplies circulating water to the first portion of the station through two 64in. mains. The water is returned to the river through a single 72in. outlet main, which discharges at a point as far away from the pump house as possible on the downstream side so as to avoid the temperature of the inlet water being affected by the warm discharge water. The outfall works have been designed so that the circulating water system works on the syphonic system, which, of course, results in a considerable saving in the pumping power. Owing to the fact that the pump house had to be constructed behind a sheet-piled cofferdam, it was made large enough to meet the requirements of the complete 300,000 kW station, but only three pumps for the existing section have been installed. Space is available for three other pumps and when the station is extended it will also be necessary to provide one additional inlet and one additional outlet main. Each of the three existing vertical-spindle Drysdale pumps at present installed is capable of delivering 1,860,000 gallons of water per hour against a head of 47ft. and may either be controlled locally or from the turbine room of the power-house. As the pumps are flooded under all conditions of tide, it has been unnecessary to make arrangements for priming them. The large isolating valves on the pump discharge header and on the two 64in. mains are motor operated. Three vertical rotating band central flow Brackett screens, each capable of screening 2,000,000 gallons of water per hour with the river at its lowest level, have been installed, and on the river side of these screens there is a fixed coarse grid screen. Each of the revolving screens is fitted with an automatic by-pass gate so that in the event of blockage by *débris* the water to the pump passes through this gate and so prevents the screen band collapsing. Although the screens discharge into a common pump suction by means of penstocks, each screen chamber can be isolated and emptied to enable a screen to be inspected or repaired.

TURBINE-HOUSE.

The three 50,000-kW two-cylinder tandem reaction type Parsons turbo-alternators—see Fig. 3 and Fig. 9 on page 144—at present installed are arranged longitudinally in the turbine-house, which, as we have said, is capable of accommodating a fourth machine of the same capacity. Running at a speed of 1500 r.p.m., each machine generates 50-cycle current at a pressure of 13,500 volts, and is directly connected to transformers which raise the pressure to 66,000 volts, and all the main Reyrolle switchgear—see Fig. 12 on page 144—is operated at this pressure. Steam is supplied to the stop valve of each turbine at 600 lb. per square inch and at 800 deg. Fah. From the exhaust of the high-pressure cylinder the steam is taken at a pressure of 115 lb. per square inch (gauge) to the combined reheater and boiler units, and is then returned to the inlet of the low-pressure turbine at its initial temperature of 800 deg. Fah. Each turbine is arranged for extracting steam at three points for the purpose of heating the feed water to a final temperature of 340 deg. Fah., when the plant is running at its economical load under normal conditions. Steam is also extracted from the turbines for evaporating the make-up water for the feed system in unit evaporators which, with the feed-water heaters, form an integral part of that system. Motor-operated turning gear, fitted to each turbine, serves for turning the rotor when starting, and in order to reduce the starting torque of this gear, an oil system, operating at a pressure of about 1500 lb. per square inch, lifts the journals off the bearings and establishes a film of oil before the turning gear is put into action.

The high-pressure steam chest is fitted with an emergency trip valve and three oil-operated governor valves, which open one after the other as the load increases. A special feature of the machines is that they have been designed to work with as flat a heat consumption curve as possible, so that from half load to full load the difference in the consumption is small. Two steam control valves are provided for the low-pressure turbine on each side of the machine, and in the event of the load being thrown off the set these valves control the steam from the reheaters to the low-pressure cylinder, for otherwise the steam stored in the latter and in the pipes would run the machine up to the tripping speed and cause the tripping gear to operate. Special devices which operate in conjunction with the reheater boiler plant have been provided to prevent the low-pressure turbine being subjected to excessive steam temperatures.

ALTERNATORS AND EXCITERS.

Each alternator is rated at 50,000 kW at 0·8 power factor, and is directly coupled to a 160-kW, 440-volt exciter, which, together with the main machine, ventilating fan motors, slip-ring brush gear, is totally enclosed and ventilated on the closed circuit system, with the air cooler placed in the foundation block. In the case of emergency, the ventilating system may be supplied with air taken directly from the turbine-room. The cooling air for the exciter and slip-ring brush gear is taken from the fan delivery duct, and returns through the air cooler without passing through the alternator, but before it reaches the cooler it passes through a "Viscous" air filter, which removes any brush dust. Although two fans are provided for circulating the cooling air, only one is needed for outputs up to the economical load of 40,000 kW at 0·7 power factor. The fan motors are pipe-ventilated machines, and take their air from the fan delivery duct. Each alternator has a motor-driven exciter field rheostat, which is controlled by an automatic voltage regulator, supplied by the Metropolitan-Vickers Electrical Company.

CONDENSERS.

For each machine there is a three-flow surface Richardsons-Westgarth condenser, designed to maintain a vacuum of 29in., when supplied with 26,500 gallons of cooling water per minute. The water-boxes at each end are divided at the vertical centre line, and have hinged end covers, so that the machine may be operated at reduced load on half of the condenser, while the other half is being cleaned on the water side. There are two steam air ejectors for each condenser, one normally serving as a standby. Condensate is used as the cooling medium for one ejector and circulating water for the other. Each condenser has two extraction pumps, each designed to deal with the condensate corresponding to a little more than half the full load steam consumption of the machine, and normally both these pumps are in operation.

HOUSE SERVICE SET.

A non-condensing Richardsons-Westgarth, 2500-kW, house service set—Fig. 11 on page 144—has been installed to provide the electrical energy for the main turbine and boiler auxiliaries in the event of a complete shut-down of the station and failure of the electric supply from outside sources, the normal supply of power for the auxiliaries being taken from the auxiliary distribution boards, which are energised either from unit transformers or the main station auxiliary transformers.

CENTRAL EVAPORATING PLANT.

Besides the unit evaporators mentioned, there is a Richardsons-Westgarth central evaporating plant, which can be used to provide the evaporated make-up water for the feed system at any time. The plant is capable of an output of 50,000 lb. of distilled water per hour. Steam is supplied to the plant at full boiler pressure and temperature, but before reaching the first stage the pressure is reduced through an automatically controlled reducing valve to 250 lb. per square inch, whilst the temperature is reduced by an automatically controlled desuperheater to 440 deg. Fah. Another interesting feature of the station is the testing equipment. Test tanks and a weighbridge are situated in a separate room at the turbine-house floor level, and after being weighed the condensate is delivered back to the system through an auxiliary pump.

(To be continued.)

Handling and Storing of Grain:

WITH SPECIAL REFERENCE TO CANADIAN METHODS.*

By H. H. BROUGHTON, M.I. Mech. E.

(Concluded from page 115.)

BUILDINGS.

THE problems encountered in the design of grain elevator buildings are, for the most part, those met with in the design of any lofty and heavily loaded structure. In a typical elevator the load on the foundations usually averages about 3 tons per square foot, over the entire area enclosed by the building lines. Heavy loads and subsoils of low bearing value give rise to many interesting problems in the design of foundations, but the consideration of these problems falls outside the scope of the paper. Frequently working house basements are below the water line, and in such cases care has to be taken to ensure water-tight construction as well as walls capable of withstanding hydrostatic pressure. The basement floor and footings, also, may require special treatment if trouble is to be avoided. The bin area in plan supported by each of the main columns in the working house varies from 225 square feet to 320 square feet in extreme cases, and, since the bins may be anything from 60ft. to 100ft. deep, it follows that the load on the ground floor section of one of these columns may be 600 to 1000 tons, of which 50 per cent. or more is accounted for by the grain in the bins supported by the column. In passing it is well to note that a 52in. octagonal column made of 1/1¼/3 concrete and reinforced with 4 per cent. of vertical steel and 1 per cent. of spiral steel, can be safely loaded to 1000 tons. When it is remembered that there may be fifty to eighty columns in a typical working house the nature of the problem will, perhaps, be the better understood. All column loads are transmitted to reinforced spread footings through reinforced piers in the basement. The portion of an elevator building above the bins is called the cupola, and to its design a good deal of attention has been given in recent years. In addition to the roof and bin-bottom slab there are usually seven or eight floors in the working house, and some of these floors are heavily loaded. The floor beams are poured at the same time as the supporting columns. Depending on the method of construction adopted, the floor slabs may or may not be poured simul-

* Paper read before the Institution of Mechanical Engineers on Friday, January 27th. Abstract.

taneously with the beams and columns. Structurally, storage houses are less complicated than working houses, because only two floors have to be provided in the majority of cases. The provision of adequate lighting and good ventilation control the design of basements and cupolas.

To the mechanical engineer the working house and storage bins form what is probably the most interesting feature of elevator buildings, as distinct from equipment. It is not so much in the design as in the mode of construction that the interest lies. Although originally intended and used for building nests of bins the method has since been applied with conspicuous success to working house and storage house structures.

Storage Bins.—Dealing first with the design of the nest or honeycomb of thin-walled reinforced concrete bins which, collectively, may hold as much as 200,000 tons of wheat in a large elevator, the storage capacity of single bins varies from 40 tons in the case of small working house bins to 1800 tons or more in the case of storage house bins, or tanks as they are commonly called, forms, to which mode of construction extended reference is made elsewhere. When the cupola of the working house is constructed in this manner the associated bins must, of necessity, be either square or rectangular in plan in order that the beams which support the several floors may be poured. For the main storage the bins are circular. In regard to cost there is little to choose between nests of 12ft. square and 12ft. diameter circular bins. Larger circular bins show an economy both in concrete and steel. In a square or rectangular bin the walls are designed as a series of horizontal beams, and reinforcing is requisite near both faces of each wall; but in circular bins the concrete carries the vertical pressure and transmits the lateral pressure to steel reinforcing designed to resist bursting.

Typical examples of working house and storage bins are depicted in Figs. 6 and 7. In connection with the former it will be noted that provision is made for housing the leg belts and for staircases, passenger elevator, ventilating ducts, pipes, and conduits. This provision results in

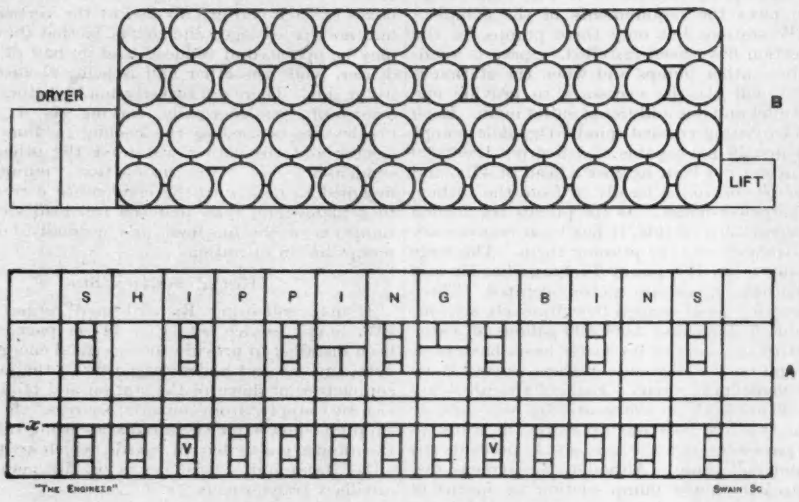


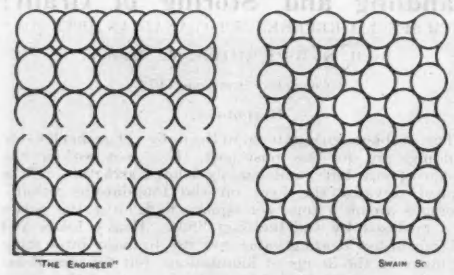
FIG. 6—WORKING HOUSE BINS

The capacities of the individual bin in the working house and storage of an elevator are governed by the character of the trade; but, in view of the multiplicity of grades, and of the many different kinds of grain to be handled, it is desirable to have many relatively small bins of varying capacities in the working house rather than a small number of large bins. In regard to storage it may be difficult to keep a large bin filled with grain of one kind and grade, and, if this cannot be done, the excess volume is dead storage. Moreover, no matter how careful the management, it is possible for a car load or more of poor quality grain to be emptied into a partly filled bin containing high-grade grain and the effect of this is to lower the grade of the whole of the grain in the bin. While this is not a serious matter if the bin is a small one it certainly is in the case of a large bin. Designers and elevator owners recognise that although large bins cost less than small bins, the latter are to be preferred in most cases, and are likely to simplify the operation of the elevator. In many of the older elevators the storage bins are of the open type, but nowadays it is customary to arrange for all the bins to be floored over and efficiently ventilated to the outside of the elevator. The inside bins are ventilated by pipes through the cupola and the outside bins by louvres under the cornice at the top of the bin walls. Basements are ventilated in a similar manner, one or more of the bins being used as a ventilating duct, as shown at V in Fig. 6. To prevent water from entering the bins all spout holes and manholes are raised 2in. or 3in. above floor level. The working house bins are equipped with valves, turnheads, and extensions from which the grain is discharged into gratings on the ground floor through closed portable spouts or into the cleaning machines through fixed spouts. Bin valves and belt loaders are provided for discharging the contents of the storage bins on to the basement conveyor belts. The bins are made of reinforced concrete and are designed to withstand the pressure due to the grain, which follows a law of semi-fluids and has been investigated mathematically by Janssen, Airy, and others. Experiments on full-size bins made by Jamieson tend to confirm the theory. Grain pressures are found to be proportional to the diameter of the bin; the lateral pressure is about 60 per cent. of the vertical pressure, and both pressures show practically no increase after a grain depth of three times the bin diameter is reached. Grain in motion exerts a somewhat higher lateral pressure than grain at rest, but the increase is negligible when the bin-bottom opening is in the centre of the bin.

Bins are invariably constructed by means of moving about 75 to 80 per cent. of the area in plan being available for the storage of grain.

The working house bins shown in Fig. 6 A have a storage capacity of 715,000 bushels (or 19,200 tons) of wheat. Two rows of bins have a depth of 87ft. and the remaining two rows a depth of 78ft.

The circular bins used for the storage houses may be anything from 12ft. to 37ft. diameter and up to 150ft. deep. Bins of 100ft. depth are common. The spaces, or interspaces as they are called, between the circular bins, are used for storage purposes, and the capacity of each interspace bin is about one-fifth that of each of the main bins. Occasionally, the interspaces are subdivided into two or four small bins. Such small bins form economical storage for odd car loads and other small parcels of grain. The bins shown in Fig. 7 *b* are 19ft. 5in. in diameter and 100ft. in height. Each bin has a capacity of 22,500 bushels and each interspace a capacity of 5000 bushels. The bins are spaced at 20ft. centres and the walls are 7in. in thickness. Flat bars on edge in three sections, bent to the curve of the bins and lapped at the joints, are used for reinforcing the bin walls.



a. *b.*

Seven different kinds of bin are shown.

FIG. 7—STORAGE BINS

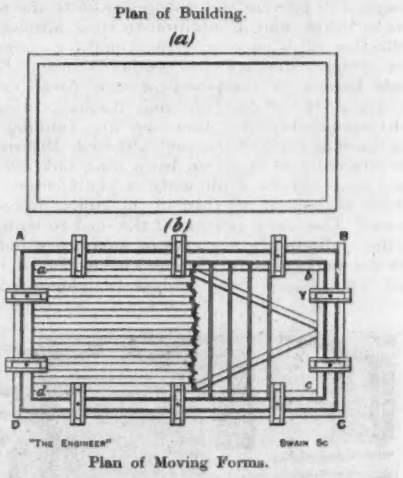
Storage Houses.—Simple storage houses of 30,000 tons and upwards can be constructed at a cost of about £2 per ton of storage capacity. The mechanical equipment consists of a number of conveyor belts above and below the bins, together with trippers and belt loaders. In some cases legs are provided to facilitate turning over the grain.

In Fig. 8 is shown a sectional view of a typical storage house. It will be noted that by raising the cupola belts above the bin floor it is possible to arrange for each belt to discharge by tripper through fixed spouting to a number of bins. In the basement only the main bin-bottom spouts and certain of the interspace spouts are shown, but the spouts from the other interspace bins are arranged in a similar manner.

Bin Thermometer System.—It has been explained that the storage house bins are usually about 100ft. deep, and that a single bin may hold 1000 tons, or more, of grain which has to be kept in good order. Overheating is an indication that the grain is deteriorating, and while it can often be cured by the aeration which results from turning over, the method is generally too costly to apply to the detection of overheating. It is customary to provide a thermometer system having stations spaced 5ft. to 10ft. apart in the storage bins. All these stations are connected to an instrument room in the storage house cupola, the several station connections for each bin being made in a box set flush in the concrete floor immediately above the bin. In addition to the indicating instrument, the switchboard has one plug and a dial switch for each bin. To read the temperature of the grain at any point in a bin the attendant merely plugs in the corresponding bin number on the switchboard and turns the dial switch to the depth at which it is desired to measure the temperature. In practice weekly readings are taken.

Moving Forms.—A novel method of elevator construction, and one which excites the wonder of the layman and the admiration of all engineers, has been developed. The novelty is that of continuously pouring concrete into a shallow mould of the shape of the building it is desired to construct, the mould being slowly and continuously moved vertically upwards till the required elevation is reached. Buildings covering an acre or more of ground, and 100ft. to 200ft. in height, are constructed in this manner without scaffolding of any kind, and the walls, columns, and floor beams form what is virtually a monolithic structure. As regards speed and economy of construction, and quality of workmanship, the method is unrivalled.

Before describing typical moulds, or "moving forms," as they are called, it is thought to be desirable to give an elementary example as an illustration. Fig. 9 *a* is the plan of a high rectangular building to be constructed of reinforced concrete on foundations assumed to be in



Plan of Moving Forms.

FIG. 9—PRINCIPLE OF MOVING FORMS

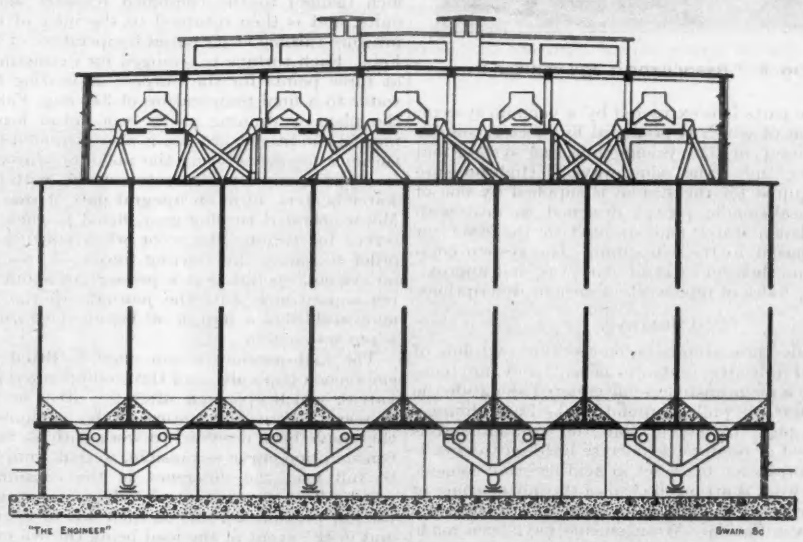


FIG. 8—SECTION OF SIMPLE STORAGE HOUSE

position. Imagine outer and inner rectangular boxes, A B C D and *a b c d*, Fig. 9 *b*, to be made 4ft. deep and of such dimensions that the space between them corresponds to the plan of the building to be constructed. The two boxes securely fastened together by a number of inverted and braced U-shaped yokes Y form a mould into which, when the reinforcing steel has been placed, concrete can be poured to a depth equal to that of the mould; but, if means are provided for slowly lifting the mould vertically as the concrete already poured takes initial set, a "casting" having a depth much greater than that of the mould can be poured. Screwjacks provide a convenient and practical method of lifting. Before pouring is commenced hard steel jack rods, shown by solid black dots in Fig. 9 *b*, are placed vertically in the mould and, as each jack rod passes through the centre and is attached to a screwjack secured to a yoke uniting the inner and outer portions of the mould—see Fig. 10—it will be seen that when the mould is just

clear of the foundations the entire weight of the mould is carried by these rods. For convenience in pouring, the portion *a b c d* is floored over, and guard rails are provided round the outer portion A B C D for the safety of the men engaged on the building. Just as easily as cores are inserted in a mould intended for the making of metal castings, so are barriers introduced in the spaces between the moving forms at the places and levels where window, door or other openings are required, and where it is necessary to reduce the size of the supporting columns.

Slow vertical movement of the forms while the concrete is setting is found not to decrease the strength of the

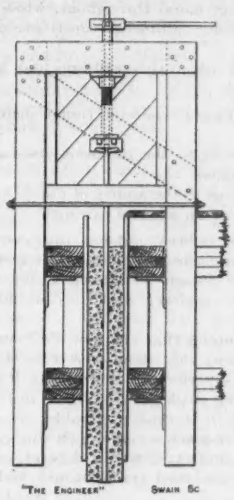


FIG. 10—YOKE, JACK, AND MOVING FORMS

concrete. The speed of pouring is governed by climatic conditions, and is limited by the time taken by the concrete in setting round the jack rods so that the latter may act as short columns in supporting the moving forms. When the jack rods pass through deep openings formed in the concrete wall, buckling is prevented by securing the rods by means of hook bolts to stout timbers set vertically in the spaces between the forms.

In practice pouring is usually carried out in two ten-hour shifts per day, and four crews per shift are employed. Carpenters maintain the forms and make such alterations as may be necessary from time to time; the steel crew places the reinforcing steel in position; the concreting men wheel the concrete in buggies from the hopper on the hoist tower to the work, and the jack men keep the jacks in motion, lifting the forms from ¼in. to ½in. at a time, the work having to be carried on practically continuously and under close supervision. On account of the many jacks and yokes that are required when the bins are small, it is necessary in some cases to provide a second unobstructed floor, or pouring platform, about 7ft. 6in. above the main floor of the moving forms. The pouring platform is used for the placing of concrete, while the main floor is used by the carpenters, steel crew, and jack men. Such double-floor forms are not needed for the construction of simple storage houses.*

CONCLUSION.

In the foregoing, consideration has been given to the machinery and methods used in one of the leading producing countries, and it is possible that doubts may arise as to the feasibility or otherwise of adopting similar methods elsewhere. The machinery and methods described in the paper, modified if necessary to suit local conditions, can be applied in most of the grain-exporting countries. It is the ambition of many of these countries to follow the Canadian plan of handling and storing when world conditions permit of financing on reasonable terms. The position of the importing countries is on an entirely different footing, and it is thought to be advisable to furnish plain answers to the following straightforward questions:—

(1) Is such machinery necessary to a wheat-importing country?

(2) Are such methods of handling applicable?

(3) Is safe storage for a large tonnage desirable or necessary?

* Further information concerning and illustrations of the moving form method of construction will be found elsewhere in this issue in an article specially written for us by Mr. Broughton.—ED. THE E.

In regard to the first two questions, for geographical and other reasons neither the elaborate machinery used nor the methods of handling practised are requisite; but a careful examination of both cannot be other than beneficial. Moreover, the adoption of the Canadian method of silo construction is recommended. In regard to the third question, the provision of safe storage for the grain supply is as important to a community as is a safe system of banking. To those whose very existence depends on the regular receipt from overseas sources of six-sevenths of their chief food supply the question of safe and adequate storage is one of prime importance.

The wheat statistics for the United Kingdom are plotted in Fig. 11. To rely, as we do rely under present conditions, on grain stored several thousand miles away is on a par with relying solely on the clouds for a water supply. To ensure a plentiful supply of water, reservoirs are constructed near the centres of consumption. In the case of the grain supply the prudent course to follow would appear to be that of providing safe storage of capacity sufficient for four to six months' normal consumption, or for 2 to 3 million tons of wheat. Such storage, spread over not less than eight centres, should be divided into about twenty-four units of various sizes which can be readily determined. Although grain stored in silos can be kept in good condition for long periods, if the plan advocated by the author were adopted the wheat would not remain in store for any length of time. It is of interest to note that the annual cost of safe storage of the capacity stated would not exceed the insignificant sum of 4¼d. to 6d. per head of the population, and the benefit derived therefrom would be a measure of security which, by no stretch of imagination, do we at present enjoy.

In the light of after events the Report of the Royal Commission on Supply of Food in Time of War, published in 1904, makes interesting reading. Both the danger to and the cost of protecting the merchant fleet were greatly underestimated. The post-war increase in the number, size, and radius of action of submarines has introduced factors about which little was known when the Report was issued.

The experts have recently been investigating the desirability or otherwise of giving a bonus or preference to our kinsmen within the Empire on the wheat they send to this country, but, in the author's opinion, the granting of a bonus should have been conditional on a guaranteed minimum tonnage of wheat being stored in the United Kingdom by the producing country. The expression "safe storage" has been used advisedly to distinguish it from other methods, known as floor and sack storage, which no country in an impoverished world can afford to use. Had the paper been concerned with grain handling in general, it would have been possible to include a number of striking illustrations showing the disastrous results attending the storing of grain in an unscientific manner. It is sufficient to state that no less than 8½ tons of mice were caught in a non-silo grain

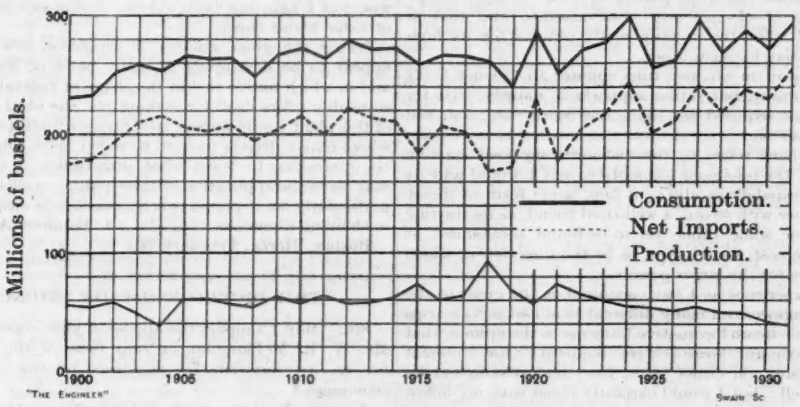


FIG. 11—WHEAT PRODUCTION, NET IMPORTS, AND CONSUMPTION IN THE UNITED KINGDOM

store in four days at a time when the people of Britain were rationed for food.

APPENDIX.

EXAMPLES OF CONSTRUCTION COSTS BY MOVING FORMS.

As the construction of reinforced concrete buildings by means of moving forms may be novel to many, the following particulars in regard to the forms, jacking, and costs may be of interest. The example selected is that of a 2,000,000-bushel elevator consisting of a 400,000-bushel working house and a 1,600,000-bushel storage house, both of which were constructed by means of moving forms:—

TABLE I.—*Costs of "Moving Form" Concrete.*

	Working house. 7740 cu. yds. of concrete.			Storage house. 9250 cu. yds. of concrete.		
	Unit costs.			Unit costs.		
	Labour.	Material.	L.+M.	Labour.	Material.	L.+M.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
Cement ..	0 9	19 10½	20 7½	0 9	20 2	20 11
Sand and gravel..	0 5	7 3½	7 8½	0 5	7 1½	7 6½
Reinforcing steel	10 10	37 2	48 0	3 2	10 7½	13 9½
Concreting plant ..	2 0½	1 11	3 11½	2 0½	1 11	3 11½
Placing concrete	13 10½	—	13 10½	7 9	—	7 9
Forms ..	13 6	3 6	17 0	9 0½	3 3	12 3½
Jacking ..	21 2½	4 5	25 7	7 5	3 8	11 1
Sundry ..	3 4	0 4	3 8	2 7	0 3½	2 10½
Cost per cu. yd. . .			140 5½			80 2½

The above costs do not include overhead expenses, contingencies, or profit.

Obituary.

GEORGE JAMES SHAVE.

As we briefly recorded in the last issue of THE ENGINEER, Mr. George James Shave, the chief engineer of the London General Omnibus Company, died in London on Monday, January 30th, after a short illness, at the age of sixty-four years. His early engineering training was received at the works of Clayton, Howlett and Co., and was followed by two years on electrical work with the firm of Paterson and Cooper, of Dalston. After leaving that firm, Mr. Shave was for some time with Mr. F. R. Brown and Messrs. Smeaton and Page, during which period he was engaged on works superintendence and outside management connected with electrical work. In 1900 he entered the motor industry, and was appointed works manager in London of the Locomobile Company of America. At a later date he became general manager of the S.M. Car Syndicate at Willesden. His association with the London General Omnibus Company began in 1912, when he was appointed works manager of the Walthamstow works of the Associated Equipment Company. In 1913 he became assistant engineer of the London General Omnibus Company and his promotion rapidly followed, for he was made assistant chief engineer in 1915, engineer in 1916, and chief engineer two years later. In 1923 Mr. Shave was appointed to the dual position of operating manager and chief engineer of the company. He was responsible for the design of the Central Overhaul Works at Chiswick, and he took the keenest interest in all branches of the company's undertaking. In 1931 he resigned from the post of operating manager but continued his duties as chief engineer until his death.

He was a member of the Institution of Mechanical Engineers, the Institution of Automobile Engineers, and the Institute of Transport, and was also an associate member of the Mechanical Warfare Board.

JAMES BRIGGS.

RAILWAY engineers will learn with regret of the death on Thursday last, February 2nd, at his home in Derby, of Mr. James Briggs, the last engineer in chief of the Midland Railway. James Briggs was born in 1855, and was educated at Castle Donnington Grammar School, Leicestershire. On leaving school he served three years with the late Mr. Gilbert Murray, estate agent to the Earl of Harrington, specialising in surveying, levelling and architectural work, a training which was admirably adapted for his later civil engineering work for the Midland Railway Company, which he joined in March, 1872. In 1880 Mr. Briggs became chief assistant to the late Mr. Frederick Campion, a position which he held for ten years, during which time he was in charge of construction work. He was appointed divisional engineer of the southern division of the Midland Railway Company in August, 1890, and seven years later Assistant Engineer for Maintenance. From December, 1904, to 1905 he performed temporarily the duties of Chief Maintenance Engineer, and those of Chief Engineer from November, 1915, to April, 1916. In October, 1917, he became Engineer-in-Chief on the retirement of Mr. W. B. Worthington. Although the amalgamation of railways, which took place in 1922 under the Railways Act of 1921, brought about some changes in staff, Mr. Briggs continued his duties of Engineer-in-Chief until his final retirement in June, 1923. He was a member of the Institution of Civil Engineers and of the Institute of Transport, and was awarded the honour of C.B.E. for the services he rendered during the late war.

GREAT ORME TRAMWAY ACCIDENT.

THE report of Lieut.-Colonel Anderson on the fatal accident of August 23rd last on the Great Orme Tramway, Llandudno, has been issued as a Stationery Office publication. The tramway is worked by cable, and the accident was caused by the failure of the draw-bar that attached the cable to the rear bogie of the car which was descending towards Llandudno. The breakage occurred at a point where the gradients varied from 1 in 3·6 to 1 in 5·9, and the car, which was fairly well filled with passengers, ran away, out of control, and left the rails at a reverse curve where it struck a wall. The motorman and a child who was riding with him at the front end were killed. The report fills nine printed pages, and is accompanied by a drawing of the draw-bar. Whilst the seriousness of the accident demanded the full investigation it received at the hands of Colonel Anderson, and his report deals with it very fully, interest in cable tramways is now very limited, so that it will suffice if we record the summary and leave those who desire fuller information to obtain the report from the Stationery Office. The main conclusions are:—

(1) The accident was primarily due to the fracture of the draw-bar, which had only been in use for seven or eight days.

(2) The cause of fracture was the use of an alloy steel, which had been given heat treatment, rendering it unsuitable, owing to lack of toughness, for the purpose in question.

(3) The use of this steel was primarily due to an error of judgment on the part of the general manager, who had not given the makers complete information as to the conditions under which it was intended to work, and, to a less extent, to the failure of the makers to ascertain the exact use for which it was required.

(4) The draw-bar had serious forging defects, for which the makers are responsible; but their effect might have been eliminated or discovered in time to avoid an accident if the draw-bar had been machined all over. This would also have facilitated inspection.

(5) The thickness of the draw-bar exceeded the designed amount, thereby reducing the clearance and increasing the liability to abrasion, which was very marked, where it passed through the slot of the conduit. This draw-bar did not, however, break at this point, but another had done so ten days previously, without any injury resulting from it. This warning had been ignored.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents).

FIRES ON LINERS.

SIR,—In designing ships of the big liner class consideration should be given to provide means whereby a fire could be confined to a section of the ship and also enable it to be fought in or near that section.

Now, the most probable cause of fires spreading is through the steel work of the ship conducting the heat from one section to another.

Fireproof bulkheads as at present constructed in passenger accommodation are not really much of a safeguard. They are certainly well insulated and in a test may prove to fulfil their purpose. Actually the steel decks and girders of the ship must be continuous metal and therefore good heat conductors, and no amount of insulation can prevent this. In fact, it is this heat running rapidly through the ship causing first smoke and driving the fire fighters away from the actual seat of the fire that is the greatest danger. What is wanted is some definite means of keeping the steel work from conducting this heat. This can only be done by cooling it with water and keeping it cool. Compartments require to be arranged with the steel work exposed all round them, also the decks and girders. Such compartments would extend across the ship and be one above the other from the deck above, the machinery spaces to the highest deck. They would be provided with perforated pipes to spray the bulkheads and decks and any heavy girders passing through them with water. The fire hydrants would be located in them. Incidentally they would be ideal places for the various pipes, such as water, steam, ventilation, to pass through from deck to deck, allowing the control valves for these services to be easily located. They would also have the advantage that the fire appliances could be tested frequently, as there would be nothing in the compartments to damage by water. Now, such compartments need not be a waste of space in a ship. That is, arranged for fire fighting and nothing else. In fact, such compartments exist on the ship already, namely, deck pantries, lavatories, bathrooms, service rooms, &c., but are usually placed irregularly along the decks. It is only a matter of arranging them above one another and in line with one another across the ship at the main or fireproof bulkheads. Deck-to-deck communication stairways or ladders could be provided through them. The fore-and-aft passages would continue through them with sliding doors at each end. They might even be arranged to lie between the same frames as the lowest ship side doors, such as oil filling compartment doors, and, of course, would open on to the highest decks. This would provide a sure means of escape in the case of fire either up or down, also a way of getting near a fire. The deck covering could be sparred wood, which could be easily lifted and thus allow the water from the spray pipes or fire hydrants to get directly on the steel. Hand pumps should be provided at each deck to enable water to be pumped from sea level to the highest decks. Baths and sinks could be used to act as tanks to give a store of water at each deck; that is, water would be drawn from the sea and discharged into a bath on, say, "E" deck. From bath on "E" deck it could be pumped to a bath or sink on "D" deck and so on to the highest deck in the ship or where it was required. This would all be done through portable flexible hoses.

It must be remembered that any water required above sea level in a ship must be pumped up on the ship itself and in an emergency the ship's pumps may not be available. Fire hydrants are usually located in the passages passing through or among the cabins. Now, in such positions they can never be periodically tested, because to actually use them would cause damage and inconvenience to passengers. They may certainly be looked at and hoses run out and put back again frequently, but the only real test is to have the valves full open and a big quantity of water flowing. In an actual fire the valves may be found immovable without additional leverage. The passage filling with smoke may make them difficult to find, as they are usually set in flush with the passage bulkhead.

All types of sprinkler and chemical appliances have the same disadvantage; you cannot test them frequently if you can test them at all. A passenger would not thank anybody for soaking his cabin with water, and the same applies to public rooms.

Electric radiators may be a real danger in ships. Not from their construction or the wiring in connection with them, but from the fact that the intense local heat they must generate could easily set paper, clothes, or any material left too close to them alight. The same applies to electric heating apparatus in deck pantries. In fact, the above may be the real cause of the recent liner fires. It would be interesting to know if they were steam or electrically heated.

Steam radiators would seem to be the safer heating system to install. Steam can also be and is used to extinguish fire.

It is questionable if putting on a large number of men as a fire patrol is really effective. Cabins must be kept private, store rooms and such places kept locked, and it is in them the fire usually starts, and when it really makes its presence known has obtained a good hold.

What is wanted is as simple as possible a means of fighting a fire as soon as discovered and means that anybody can use. This can easily be done from compartments such as lavatories arranged as suggested. They would provide easy access from deck to deck and could be used by the ship's crew for this purpose. They are well ventilated and have exhaust fans fitted; this would be an asset in getting smoke cleared away. The steel work in them is generally only painted and is thus exposed. Fire hydrants in them would be exposed, not be behind or in recesses where a small door has to be opened to get at them. The fire hydrants can also be tested at any time without inconvenience, thus allowing real fire drill to be carried out, which is necessary to handle even such a simple thing as a fire hose. As the compartments would have portholes at the ship's side, when the ship is in dock and their own pumps stopped, fire hoses could be taken in from the shore ready for any emergency.

As all that has been suggested already exists, but only has to be rearranged, there is no increased cost added to put it into practice in any new ship and would help to make British liners even more safe than they are.

February 3rd. R. A. M.

OIL-ELECTRIC LOCOMOTIVES.

SIR,—The correspondence in your issue of January 27th is a well-deserved tribute to Colonel Fell's paper, and some set-off to the silence of the many railwaymen who are qualified to speak on this subject.

May a non-railwayman, who values several instructive years of association with that most helpful and hospitable other section of mechanical engineers, raise his voice against the misleading way in which some of his colleagues of the internal combustion section—alas, including Colonel Fell himself—apply the term brake horse-power to locomotive capacities?

It is not brake horse-power, *i.e.*, the horse-power given out at the shaft of the internal combustion engine, which the railwayman wants to buy, but the horse-power actually delivered at the rail. To use the former term is begging the whole question of transmission, which is admitted to be both technically and commercially the crux of the problem involved in obtaining for rail traction the economy and other advantages of the oil engine. Rail horse-power, on the other hand, includes the degree of success or otherwise with which we have solved the transmission problem; a 1000 B.H.P. oil engine is unlikely to deliver more than 750 maximum rail horse-power, after the twofold energy conversion of electric gear transmissions, and that is typical of what the railway really obtains for its high capital outlay for such types.

This aspect in no way runs counter to Colonel Fell's main argument, but rather supports it, namely, that for the powers required for main line work, say, 750 rail horse-power and over, electric transmission is too costly.

Mr. Willans refers to the extraordinary load starting powers of the oil-steam locomotive, and I would add its overload capabilities also; in fact, some form of direct drive, either with steam, a well-tried friend, as its starting partner, or some other yet-to-be-found mechanism at reasonable cost, would seem to be the direction in which success lies for the larger powers.

Such experience as I have acquired as the guest of the railway engineers on many different trial and service trips with the oil-steam locomotive leads me to the opinion that the "maximum horse-powers required" for different services have, on either basis, been under-estimated by Colonel Fell; but I would earnestly plead with my fellow internal combustion engineers not to prejudice a good case in the eyes of their railway colleagues by unintended exaggeration of their figures while their own contribution to progress is yet young. H. A. D. ACLAND,

London, February 7th. M.I. Mech. E.

SIR,—With reference to the letter signed "K. W. Willans," in your issue of January 27th, wherein your correspondent suggests that the medium-speed oil engine is indicated for mineral and shunting traffic, "as, there being no passengers, the heavy torque recoil will not worry them," I suggest that, even if there are no passengers there will be a guard at the end of the mineral train, and that the heavy torque recoil calls for equally as much consideration in mineral as in passenger traffic, considering the prevalence of loose-coupled mineral rolling stock in Great Britain. Any practical locomotive man knows of the great care which has to be exercised in "picking up" a mineral train of any length, more especially when running, if "break-looses" are to be avoided. It would seem of prime importance, therefore, that the designer of the oil-engined mineral locomotive should endeavour to make the latter as flexible in operation as the conventional steam locomotive. W. G. F. THORLEY, S.I. Mech. E.

Wellingborough, February 6th.

ALL-STEEL RAILWAY COACHES.

SIR,—In Mr. C. E. R Sherrington's letter appearing in your issue of January 27th it is stated that under British conditions all-metal carriages are found to be more costly to construct and are heavier than carriages of which the bodies are made of wood, and the authority for this is given as Mr. H. N. Gresley's report to the Cairo meeting of the International Railway Congress Association.

For the benefit of those who have not studied this report in detail it may be pointed out that this is somewhat misleading. Examination of the report shows that this statement is merely a transcript of the evidence of one British railway, which states, further, that its shops are laid out for building and repairing wooden bodies (a point which is not without its importance when the costs of all-steel and composite construction are being compared for that railway).

The British railway which has the greatest percentage of all-steel stock has not yet sufficient information as to costs, &c., to decide on its policy. Out of thirty-three railways which answered the questionnaire, thirteen definitely state that it is their intention to build new carriages in metal throughout, while a further four intend to develop all-metal construction to a limited extent.

The reasons why other railways did not adopt this attitude include:—

(*a*) The desire to use local timber instead of imported steel,

(*b*) Doubt as to the corrosion resistance of steel in tropical climates,

(*c*) Doubt as to the ability of native labour to undertake repairs to an all-steel carriage,

and only one railway outside this country definitely states that composite construction is superior to all-steel.

None of the reasons scheduled above would seem to apply in this country, while (*a*) would be definitely reversed.

It may be noted that the new Pullman stock for the Southern Railway electrification is of all-steel construction and has been described in the railway Press as "among the finest rolling stock yet introduced in this or any other country." If it is thus preferable to employ all-steel construction for coaches running on this system, certainly the Northern railways, which depend so much on the prosperity of the steel trade, would find it even more beneficial. C. J. KAVANAGH.

London, February 2nd.

THE HUMPHREY PUMP.

SIR,—I note that efforts are being made to revive this very interesting method of pumping water, which has always seemed to me to have been worthy of a far wider development than actually appears to have been achieved.

So far as my information goes, the Metropolitan Water Board's plant at the King George reservoir, Chingford, which was installed, I believe, in 1913, or thereabouts, is still giving every satisfaction, and I understand somewhat similar pumps were erected in Australia after the war, but I have not been able to obtain any information of value about them.

Seeing the great number of irrigation schemes that appear to be developing in many parts of the Empire, and in which native fuel in the shape of vegetable matter so readily offers itself for making gas, the ideal simplicity of this plant would appear to commend itself, particularly where native drivers have to be relied upon, and it would be interesting to learn what drawbacks, if any, there may be to the application of these pumps to such schemes, particularly in a period when economy is being sought in so many directions. A. HUGHES, A.R.S.M.

Bushey, Herts., February 7th.

"THE DICTATORSHIP OF SCIENCE."

SIR,—May I support the appeal of your correspondent, Mr. W. R. McLaughlin, in your issue of the 3rd inst., for an investigation by engineers of the subject of economics?

As a result of the work of the engineer, the world is faced to-day with the so-called problem of unemployment and poverty in the midst of plenty. It would appear that the only reason for this situation being regarded as a problem at all, is that our present financial system, which was evolved in an age of scarcity, is incapable of carrying out its proper function of distributing the goods and services available, owing, apparently, to the inability of those in charge of the system to realise that the age of scarcity is past.

Engineers are under no such delusion, and if they would study this matter and call for evidence from such independent investigators as Major C. H. Douglas, their findings should be of the greatest value.

M. YACKLIN.

West Clandon, Surrey, February 6th.

"ORDER Signalling for Marine and Power Station Equipment" is the title of a paper to be read before the London Students' Section of the I.E.E. on February 17th by Mr. H. Newald. The paper is an effort to bring to the notice of students a form of electric lamp signalling which may not be very well known to them. The principle employed is the illumination of electric lamps behind screens on which are printed in a suitable manner the signals or "orders" to be transmitted. The order is selected by the engineer in the control room on a type of selecting switch, and is shown in the engine or boiler room on a suitably lettered screen to suit requirements. The apparatus is simple in principle, but complication arises in practice owing to the necessity of transmitting back to the control room a reply signal of some kind so that the engineer may know that his signal has been definitely received. For this purpose relay circuits are employed. This system is used almost universally in modern power station equipments, and a large proportion of modern liners are equipped with some form of luminous signalling apparatus.

Railway and Road Matters.

ORGANISATIONS whose members would be affected if the proposals of the Salter Conference were given legislative effect have received from the Minister of Transport a letter in which he asks what restrictions now imposed on the railway companies could, in the opinion of these organisations, be removed without detriment to the public interest. The various associations are now engaged in considering their replies.

ON three occasions towards the end of last year, the Southern Railway reported increases in coal traffic. An official statement made by that company suggests that those increases came from the Kentish coal traffic. The tonnage figures from the Kent collieries were 1,000,000 tons in 1930, 1,300,000 tons in 1931, and 1,500,000 in 1932. The Southern Railway Company itself uses 400,000 tons of Kentish coal during a year.

BY adopting electric welding for locomotive fire-box repairs, the French State Railways have been able to effect extensive repairs to the foundation ring and lower part of the box without lifting the boiler from the frames. The economy effected by this method is from 10,000f. to 12,000f., depending upon the extent of the repairs, and whether or not the boiler was difficult to take off in the old manner, but experienced and conscientious welders have been found indispensable.

THE fatal collision of January 31st, between a down express passenger train and a goods train that was being shunted at Loughborough, L. and N.E.R., was inquired into on Monday last by Colonel T. Trench. After visiting the scene of the accident, it was announced that the evidence would be given in private. From that it may be assumed that either there is a dispute between the signalmen in the two boxes concerned as to what block signals were exchanged, or between the driver and the signalman as to the condition of the outdoor signals.

WE are sorry to hear of the recent death of Mr. Bowman Malcolm, who enjoyed the unique record of having, in 1877, been appointed the locomotive superintendent of the Belfast and Northern Counties Railway when only twenty-two years of age, and, moreover, holding that position for forty-six years, making his total service with the Northern Counties system one of fifty-two years. Further, on the death of Mr. Berkeley D. Wise, the chief civil engineer, in 1906, he took over the duties of that department also. Mr. Malcolm was the inventor of a compound locomotive.

ON the morning of Wednesday, February 1st—the second day of the strike on the railways in Northern Ireland—a mail train from Dublin to Belfast was derailed between Castlebellingham and Dundalk. The passengers, engineman and guard were unhurt, but two railway servants in the derailed coaches were killed. As the scene of the accident is in Free State territory, the Minister of Industry and Commerce sent the railway inspecting officer, who reported that the derailment was caused by the removal of a rail. The Minister thereupon announced that the matter was one for the police to deal with.

DURING the three months ended June 30th last the assistant inspecting officers of the Ministry of Transport held forty-two inquiries into the more serious accidents to railway servants, of which twelve were fatal cases resulting in the death of thirteen men. In eight of the fatal cases the cause assigned was want of care; in two to misadventure; in one no look-out man was provided to protect men at work; whilst in one, two men were killed whilst painting a roof, owing to a rope breaking, the defect in which could not be noticed. Of the thirteen men killed, six were working on the permanent way.

IT is officially announced that a contract for the construction of a complete oil-electric express train has been placed with Sir W. G. Armstrong, Whitworth and Co. (Engineers), Ltd., of Newcastle-upon-Tyne. The train, which has been ordered by the San Paulo Railway of Brazil, is believed to be the first complete oil-electric train ever ordered from one firm. It is to run at express timings between San Paulo, the capital of the State, and the harbour of Santos. The timing of the journey to and from the coast will be less than any previously known, partly on account of the increased speed and partly on account of the saving of time when traversing the great incline known as the New Sierra.

SPEAKING at the dinner of the Dover Chamber of Commerce on January 27th, Colonel Szlumper, the assistant general manager of the Southern Railway, suggested that Dover could not become a true seaside resort, and that it would be wise to aspire to become the Southampton of the South-East; it must make the choice between commerce and pleasure. At a meeting of the Dover Town Council four days later, a member said that, in his opinion, the present position was untenable, and his suggestion was that representatives of the Town Council, the Harbour Board, the Southern Railway, and the Chamber of Commerce should go into the question and form a comprehensive programme for the development of town and port. A sub-committee was subsequently appointed to inquire into the matter.

THE new President of the Institution of Railway Signal Engineers, whose election was confirmed at the general meeting on Wednesday, February 8th, is Mr. W. Challis, the chief assistant to the assistant engineer (signals and telegraphs), Southern Railway. Mr. Challis' youth was spent in the telegraph manufacturing works of Spagnoletti and Crook, and he then joined the telegraph department of the Metropolitan Railway, and remained there for twenty-three years, working his way up to the rank of inspector and eventually, in 1922, becoming the signal and telegraph superintendent. In 1924, he was responsible for the installation of colour-light signals on the 8 route-miles between Harrow and Rickmansworth, and when, in the following year, the Southern Railway started its big scheme for power and automatic signalling in connection with its electrification, he went to that company as assistant to the late Mr. W. J. Thorrowgood, and now holds a similar position under Lieut.-Colonel Hall, the assistant engineer (signals and telegraphs).

Notes and Memoranda.

AT an American works a photo-electric control of lighting is claimed to save 4000 kilowatt-hours monthly, reduce lamp replacements one-fourth, improve production, and reduce accidents. The lights in the plant are automatically turned on during cloudy weather and extinguished when daylight returns to normal intensity.

REPRESENTATIVES of the Western Electric Co. are now experimenting with their "sound meter" in various cities, filing their results at their Cricklewood Works, London. The noisiest spot in London, according to last week's survey, was in Fleet-street, where the volume of sound measured 83 decibels. Lombard-street, in the financial quarter, and the Embankment were comparatively quiet, registering only 63 decibels.

IN the course of recent investigations by Dr. Broche, a method was discovered of using tar oil instead of gas oil in Diesel engines. It is based on the fact that oxidising catalysers, *e.g.*, vanadium pentoxide, thorium oxide, or platinum, possess the property of lowering the ignition point of tar oil to that of gas oil. When provided with special contact bodies, Diesel engines, according to the report, run equally well on tar oil as on gas oil.

To handle peak loads and at the same time utilise the excess energy available at night the Société de l'Energie Electrique du Rhin is constructing a pumped storage plant to be connected by transmission lines with the Kembs project. Two natural lakes about ¾ mile apart, with a mean difference in level of 357ft., are being used. Water will flow from Lac Blanc by way of a tunnel and pipe line through turbines into Lac Noir, and after being used will be pumped back into Lac Blanc. The maximum variation in the water level will be approximately 60ft.

A STRINGENT test for the photo-electric "eye" was carried out in New York on January 20th, when a woman singer's voice modulated a beam of light half a mile in length, extending from one New York skyscraper to another. The beam actuated a photo-electric cell which, in turn, modulated the broadcast carrier wave. The transmission was duplicated over the ordinary line, the engineers being able to switch from one to the other method without notifying listeners, who were unable to tell which method was being used at any given time.

THE copper-oxide rectifier has now been in use long enough to enable it to be said that its characteristics are not seriously affected by ageing. According to tests by H. Böhn, extending over a period of 17,000 hours' service, they show that the copper-oxide rectifier has special advantages in the trickle-charging of accumulators, and is readily adaptable to measuring purposes. At the normal room temperature (22 deg. Cent.) the reverse current in the case of a battery-charging rectifier was 0·3 per cent. initially, and 3·3 per cent. after 12,800 hours' service, with the A.C. supply disconnected.

THE 10,000 kW mercury plant at Hartford, Conn., has now been in successful operation for a fairly long period, and in the last five months has generated 73 million units at a fuel rate of less than 10,000 B.Th.U.'s per unit supplied, which corresponds to a thermal efficiency of more than 34 per cent. The load factor, states *The Electrical Times*, was 87 per cent., and the "use factor" 96 per cent. American engineers do not always calculate these figures in the same way as British engineers, but it is obvious that the Hartford plant was treated as a base load station with a load factor not very far distant from 100 per cent.

THE methods of extracting petroleum from sands or sandstones by wells have been studied for years; but, while methods have been greatly improved in the last decade, the present percentage of extraction of the total amount of oil in the sands, according to various petroleum authorities, is usually only 10 to 30 per cent. If stimulative methods are used under favourable conditions the recovery may be greater. The United States Bureau of Mines has published a book on the subject, entitled "Mining Petroleum by Underground Methods: A Study of Methods Used in France and Germany, and Possible Application to Deplete Oil Fields Under American Conditions."

A NEW method of electrolysis for obtaining such rare metals as uranium, thorium, and tantalum, in the pure state, has been developed by Dr. Frank H. Driggs, of the Westinghouse Lamp Company. In the process a cathode is inserted in a liquid bath containing equal parts of sodium and potassium chloride, to which has been added a quantity of potassium thorium fluoride, when the metal thorium is desired. After powdered thorium has collected to a thickness of about 1in. on the cathode, it is removed and replaced immediately with another cathode. This feature makes the process continuous. It is not necessary to destroy the entire bath in order to obtain the metal deposits as in other processes. On removal from the liquid bath, the solution clinging to the cathode is washed away, the powder being preserved in an atmosphere of ether or in a vacuum. After it is pressed into bars the rare metal does not oxidise at room temperature and henceforth can be handled freely.

THE control of ignition-coil discharge characteristics is discussed in a paper read by Messrs. G. I. Finch and R. W. Sutton, of the Imperial College of Science and Technology, read before the Physical Society in London. A theory has been developed and verified by means of the cathode ray oscillograph. The secondary discharge consists of two parts: the "capacity" component due to the discharge, upon breakdown of the spark gap, of the energy stored in the secondary capacity; and the subsequent discharge of the electro-magnetically stored energy, the so-called "inductance" component. The spark gap voltage is constant throughout the life of the inductance component, and the inductance component current is oscillatory, but unidirectional. The theory leads to the conclusion, confirmed experimentally, that the closing of the primary circuit during the life of the inductance component rapidly extinguishes the secondary discharge. A contact breaker, enabling the duration of opening of the primary circuit to be controlled with accuracy over a range between 0 m. and 2 m. sec., is described. The elimination of various portions of an ingition coil discharge, without material effect upon the remainder of the discharge, is also discussed.

Miscellanea.

THE new reinforced concrete bridge over the river Stowe at Stafford has been opened.

IT is intended to erect 700ft. high aerial masts at the new National transmitter station at Wychbold.

THREE new mines were added to the gold producers of Ontario during November, bringing the present total to twenty.

THE quantity of white and rock salt made in Great Britain in 1930 was 750,600 tons, and the average selling value was £1 10s. a ton.

A PROPOSAL is being considered for the using of the Mersey Tunnel for fast motor traffic before it is formally opened to general traffic.

A NEW Marconi automatic wireless beacon is to be installed on the Irish lightship "Comet." The beacon will be operated in conjunction with a submarine sound signalling device.

A REGULAR service of steamers is being maintained throughout the winter by Furness, Withy and Co., between St. John, New Brunswick, and Vancouver and Victoria, *viâ* the Panama Canal.

SINCE 1922 a total area of 402,500 square miles in Canada has been mapped by aerial photography, comprising 125,000 square miles by vertical photographs and 277,500 square miles by oblique photographs.

IN Germany, 1740 oil-engined vehicles, including forty oil omnibuses, are on the road at present, says *Engineering Progress*. The corresponding figures for England are 800 and 300. In France there are 1200 oil-driven cars.

AEROPLANES have been used in the Panama Canal zone for dusting Paris green for the extermination of mosquitoes. Five dustings were required, the best result being from a 10 per cent. by weight of Paris green with fine local clay dust.

THE cost of materials used in coal mines during 1930 was £27,791,000, the net output £137,101,000, and the value of net output per person £148. The corresponding figures in 1924 were £41,608,000, £209,729,000, and £175 respectively.

THE Hydro-Electric Power Commission of Ontario is now working on a plan to equip all homes with a simple type of electric hot water heater, with the object of absorbing the surplus power developed by the hydro-electric scheme.

THE Link Belt Company has produced a variable-speed unit that turns from 0·00594 r.p.m. to 0·000408 r.p.m. The total reduction from the constant speed shaft of the gear to minimum speed of the control screw is 1,840,000 to 1. There is also an automatic time cycle control.

REMARKABLE demonstration of the long life and sustained strength of pressure-treated pine poles has been made in a line construction in America. Poles with fifteen years of service have been reset for a new line in the full expectation of many years of sustained service.

MORE than 8,000,000 lb. of dynamite have been used in the construction of a water tunnel to augment the supply of New York City. The tunnel is 20 miles long and has a finished diameter of 17ft. Its construction involved the sinking of seventeen shafts to an average depth of 600ft. and the blasting was practically continuous for three years.

THE Council of the Institution of Naval Architects has awarded the Premium for the year 1932 to Dr. G. Kempf and Herr H. Lerbs, of the Hamburg Experimental Tank, for their joint paper, "Cavitation Experiments on a Model Propeller." The Premium will be presented at the opening meeting of the annual general meetings, which will be held on April 5th next at the Royal Society of Arts, John-street, London, W.C.2.

ACCORDING to the *Railway Gazette*, on the Midi section of the electrified Toulouse-Barcelona line, a snow plough of entirely new design has just been set to work. Intended to clear away snow to a depth of 5ft., two rotary wheels with a diameter of 4ft. are employed, but these may be swivelled as required through an angle of 180 deg., and are effective over a width of 10ft. 6in. Current for the two 130 H.P. scoop motors is taken from the overhead line by a pantograph, but the 13-ton vehicle has no traction motors and is propelled at a speed of 3½ to 6 m.p.h. by an electric locomotive.

SUPPORTED by the strong recommendations contained in the report of the British Economic Mission which visited the Far East in 1930–31, a Joint Committee of the China Association and Federation of British Industries was set up at the end of last year to formulate a scheme whereby British industry might obtain the maximum advantage to be derived from the education of Chinese students under British influence. This scheme has resulted in the Federation's securing a grant from the funds available for the purpose of defraying expenses connected with the technical training of Chinese students in the United Kingdom, and arrangements are now being made by the Federation for the placing of students in engineering works in this country.

THE Dominion Department of Mines at Ottawa has just issued volume No. 11 in the Economic Geology Series of the Geological Survey Branch, entitled "Rare-element Minerals of Canada," by H. V. Ellsworth. This comes at an appropriate time when public interest is being aroused in the radium developments at Great Bear Lake and elsewhere. The volume is one of thirteen chapters, containing several plates and diagrams. Chapters II., III., IV., and V. deal in detail with lithium, rubidium, caesium, beryllium, zirconium, and hafnium, tantalum, and columbium and their minerals. Chapter VI. deals with the rare earths, and Chapters VII. and VIII. with uranium and thorium, as well as minerals and earths containing these metals. Copies of the volume can be obtained (price 40 cents) on application to the Director, Geological Survey, Ottawa, Canada, and it can be consulted at the reference library, Canada House, Trafalgar-square, London, S.W.1.

THE NEW DUNSTON POWER STATION OF THE NORTH-EASTERN ELECTRIC SUPPLY COMPANY

(*For description see page* 136.)

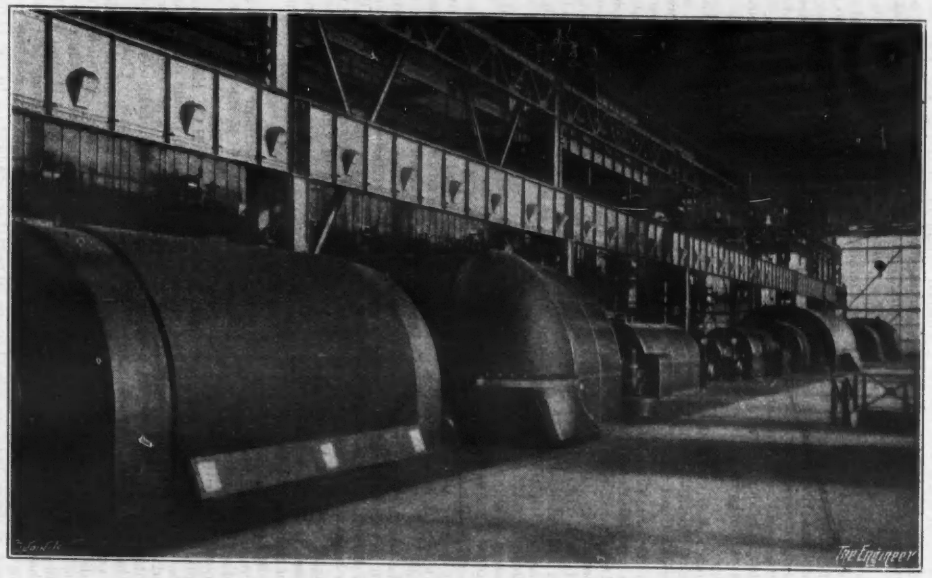


FIG. 9—50,000 kW TURBO-GENERATOR SETS

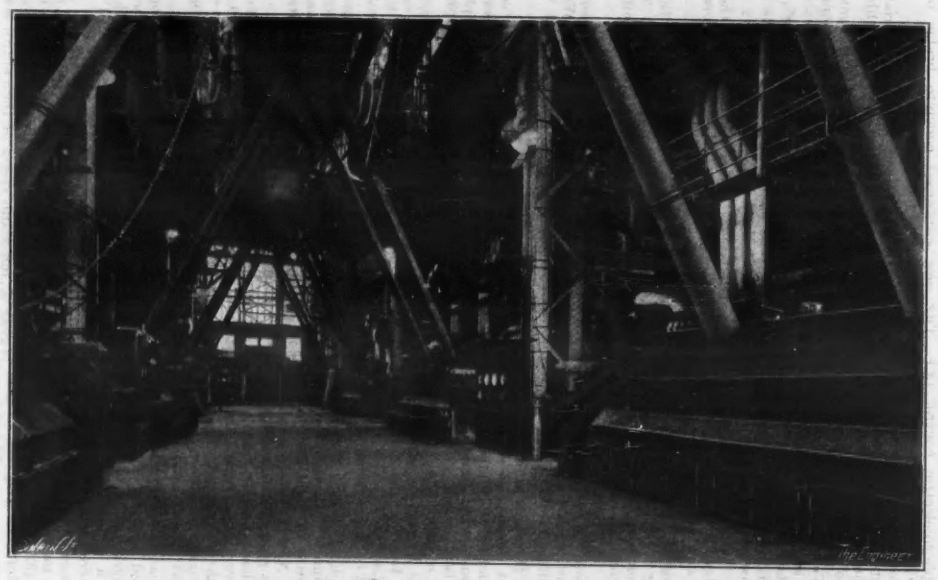


FIG. 10—STOKER-FIRED BOILER HOUSE

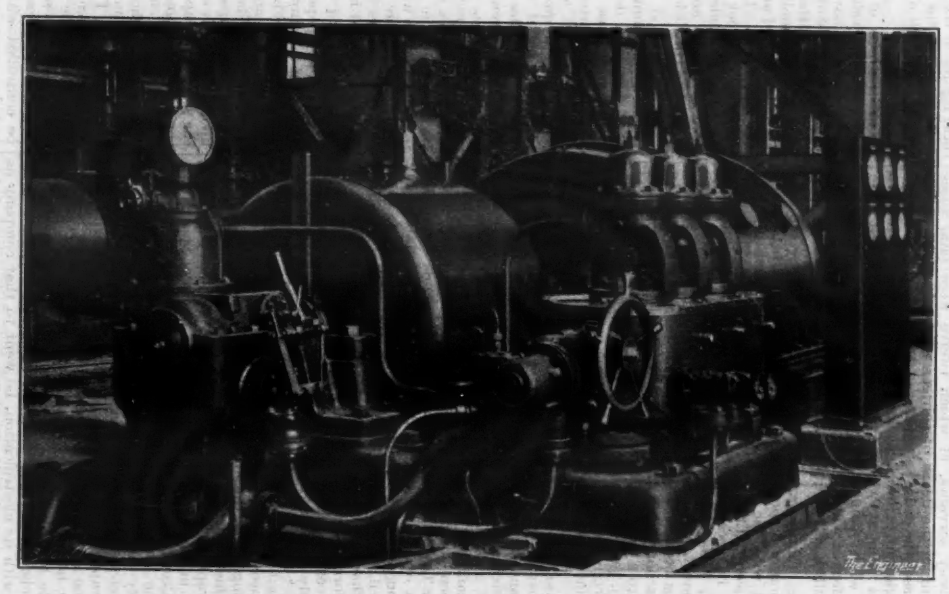


FIG. 11—2500 kW HOUSE SERVICE SET

FIG. 12—66,000 VOLT METAL-CLAD SWITCHGEAR

The Engineer

FEBRUARY 10, 1933.

VOL. CLV. No. 4022

Contents.

THE ENGINEER, February 10th, 1933. PAGE

A SEVEN-DAY JOURNAL 133
MOVING FORMS FOR CONCRETE CONSTRUCTION. (Illus.) 134
OPTIMUM DIAMETER OF DRIVING WHEELS 135
THE NEW DUNSTON POWER STATION. No. I. (Illus.) 136
HANDLING AND STORING OF GRAIN. (Illus.) 139
OBITUARY—George James Shave—James Briggs 141
GREAT ORME TRAMWAY ACCIDENT 141
LETTERS TO THE EDITOR—
Fires on Liners—Oil-electric Locomotives—All-steel Railway Coaches—The Humphrey Pump—The Dictatorship of Science 142
RAILWAY AND ROAD MATTERS 143
NOTES AND MEMORANDA 143
MISCELLANEA 143
LEADING ARTICLES—
The Kandó System 145
Commercial Treaties 145
THE ROYAL SOCIETY'S MOND LABORATORY. (Illus.) 146
SIXTY YEARS AGO 147
NEW MEDIUM SPEED OIL ENGINE. (Illus.) 148
SOUTH AFRICAN ENGINEERING NOTES 150
ROYAL CORPS OF NAVAL CONSTRUCTORS 150
BERMUDA RAILWAY FREIGHT LOCOMOTIVES. (Illus.) 151
THE HESTON AIR PORT CLOCK. (Illus.) 151
ENGINEERING IN JAPAN 151
L.M.S. SADDLE-TANK LOCOMOTIVES. (Illus.) 151
KEENOL LUBRICANT 151
500-TON COMPRESSION TESTING MACHINE. (Illus.) 152
PROVINCIAL LETTERS—
The Midlands and Staffordshire 153
Lancashire 153
Sheffield 154
North of England 154
Scotland 154
Wales and Adjoining Counties 155
EDUCATIONAL INTELLIGENCE 155
PERSONAL AND BUSINESS ANNOUNCEMENTS 155
CONTRACTS 155
CURRENT PRICES FOR METALS AND FUELS 156
FRENCH ENGINEERING NOTES 157
BRITISH PATENT SPECIFICATIONS. (Illus.) 157
FORTHCOMING ENGAGEMENTS 158

TWO-PAGE SUPPLEMENT—MOVING FORMS APPLIED TO THE CONSTRUCTION OF REINFORCED CONCRETE BUILDINGS.

NOTICES TO READERS.

*** *If any Subscriber abroad should receive* THE ENGINEER *in an imperfect or mutilated condition, he will oblige by giving prompt information of the fact to the Publisher, with the name of the Agent through whom the paper is obtained. Such inconveniences, if suffered, can be remedied by obtaining the paper direct from this office.*

*** *For Subscription rates, see page 2 of Advertisements.*

*** *All letters intended for insertion in* THE ENGINEER *or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

*** *No undertaking can be given to return drawings or manuscripts; correspondents are therefore requested to keep copies.*

THE KANDÓ SYSTEM.

AFTER much investigation and experimental work, extending over a long period, a section of the Hungarian State Railways has been electrified in accordance with the ideas of the late Dr. Kandó. The placing of some of the work in this country was due to financial rather than technical reasons, for had it not been for the granting of a British loan under the condition that England should receive a share of the orders for equipment, it is highly improbable that any British firm would have been associated with the job. As far back as 1924 Professor Verebély described the outstanding features of the Kandó system in THE ENGINEER, but at that time the work that had been done was purely experimental. The first trial runs were made in 1923 on a specially equipped line between the Budapest Western Station and Alag, when the basic idea was found to be sound. Five years later the tests were renewed on the same line, with the locomotive redesigned with a view to overcoming the shortcomings of the original engine. Tests extending over a period of more than two years indicated that all requirements could be met, for a total of 38,526 miles were covered by the locomotive, which, although designed for goods service, also hauled express passenger trains. As the descriptive articles which we have recently published show, thirty-six 2500 horse-power locomotives have been ordered for the line between Budapest and Hegyeshalom, a distance of 120 miles, of which 60 miles from Budapest to Komárom have already been electrified. Two passenger and two goods 2500 horse-power locomotives are in operation. Thus the Kandó system, of which so much has been heard, has now established itself as an alternative to the usual systems of less recent origin.

Few electrical engineers can now be unaware of the fact that the Kandó locomotives are supplied with 50-cycle, single-phase current, which can be drawn directly from the lines of a national supply system, such as the British "Grid." No frequency changing or other converting sub-stations are needed, but simply 50-cycle static transformer sub-stations spaced long distances apart. On the other hand, phase conversion has to be carried out on the locomotives, which, with the necessary equipment involved, must be rather expensive. Although the Kandó locomotives are designed on original lines, the proposal to convert the single-phase current collected into another kind of current on the locomotives is really very old. In 1891 Mr. Ward Leonard proposed to equip locomotives with motor generators for converting single-phase current into D.C. for supplying the traction motors. Locomotives of that type have been built in America, where engines on which the incoming single-phase current is converted into three-phase current have also been constructed. In both cases the advantage of a high distribution pressure can be secured without employing A.C. series commutator motors, which necessitate a low periodicity. In the former case, the scheme really amounts to utilising single-phase to D.C. mobile motor generator plant instead of the usual three-phase to D.C. rotary converter or rectifier sub-stations, working at a maximum pressure of 3000 volts at the side of the track. But as these locomotives have only been employed to a limited extent, it is evident that they are undesirable, save under exceptional circumstances. Excessive weight and cost and rather poor efficiency are said to be their main disadvantages. Many will probably contend that the Kandó locomotive with its water and oil-cooled phase converter, special multi-phase motor, oil and water pumps, liquid starter, and other special equipment, must also be heavy and costly. There are engineers in this country, we fancy, who will assert that although there are savings in some directions, there are extra expenses in others, notably as regards the replacement of all overhead telephone and telegraph lines alongside the track by underground cables, and what the Hungarian railway authorities are gaining on the swings they are losing on the roundabouts. It is claimed, however, that the Kandó locomotives are simpler, lighter, and cheaper than the converter locomotives that have been built in America. Stress is laid on the fact that the phase converter is used for reducing the incoming pressure, as well as for changing the number of phases, thus avoiding the use of a static transformer. But as alternators are now being built to generate at 33,000 volts, we do not see why 16,000 volts should not be supplied to the stator windings of a locomotive motor generator. The main advantage of the Kandó system is, of course, that it eliminates the frequency changing sub-stations necessary with the ordinary single-phase system, and the more numerous rotary converter or rectifier sub-stations associated with the relatively low-pressure D.C. system. For the electrification of the line from Budapest to Hegyeshalom, a distance of 120 miles, it will only be necessary to provide static transformers at four points. But in this and certain other countries the multiplication of sub-stations, containing plant far more expensive than transformers, does not seem to be regarded as a serious matter. There is, of course, a vast difference between suburban electrification and long-distance electrification, with less dense traffic, but it is worth mentioning by way of indicating how many sub-stations this country is likely to possess if the low-pressure D.C. system continues to hold its own, that on the Southern Railway suburban system alone there are forty-eight rotary converter sub-stations containing over 200,000 kW of plant, whilst the electrification of the line to Worthing has necessitated the provision of an additional eighteen sub-stations, with a total capacity of 45,000 kW in the form of rectifier plant. Although it is generally agreed that for suburban work the low-pressure contact rail system, with sub-stations at frequent intervals, is the best, it is not improbable, in view of the distances that are now being covered, that some engineers are beginning to wonder whether a low pressure is always justifiable. From recent estimates it would appear that, apart from America, this country already has more A.C.-D.C. sub-stations than any other country in the world. For railways and tramways and other purposes, Great Britain is said to employ 2,355,888 kW of rotary converter and rectifier plant, Germany 1,618,417 kW, and America 4,601,775 kW.

Before the advent of automatic and remote-control gear, the wages bill for an average railway sub-station amounted to about £1200 a year, a fact which probably led some engineers to believe that D.C. should not be used for long distances. But since it has become common practice to control a number of sub-stations from a central point, the cost of operation, even when the additional capital cost is taken into account, has been considerably reduced. For this reason, among others, most British engineers seem to have ceased to give A.C. traction a thought, although in such countries as Germany, Switzerland, Hungary, and Sweden, it is still considered to be the best for main lines. As far as reducing the capital and working expenses of sub-stations is concerned, the Kandó system has much to recommend it, but for reasons which we have indicated, it is doubtful if it will meet with universal praise. If at a later date some other form of 50-cycle, single-phase locomotive, such as the Brown-Boveri rectifier locomotive, should prove satisfactory, there would clearly be no difficulty in employing it in Hungary or in any other country that might deem it desirable to utilise this new and interesting system.

Commercial Treaties.

THE British Chamber of Commerce in Paris has made an investigation amongst its members into the abnormal situation created by the accessory taxes and charges that inflate the duties on British goods imported into France. The extent of that inflation is generally unsuspected by British manufacturers, who are unaware of the disparity that exists between the fiscal restrictions in the two countries, to the detriment of British trade. The time for recriminations is past, and all countries must get to work to remove impediments to international exchanges. The difficulties in the way of foreign business are the principal cause of the world depression. Without them there would always be a possibility of doing business under competitive conditions, whatever might be the financial and political disturbances, the effects of which are simply aggravated when all countries close their markets to foreign goods. While Great Britain was freely open to foreign products the policy pursued abroad of reducing purchases with the idea of securing a favourable trade balance and protecting home industries was fairly general everywhere. That policy was intensified by the growing financial difficulties, with results that proved disastrous to foreign countries when Great Britain was obliged, in self defence, to take measures against the invasion of goods from countries that had closed their own markets. That was the turning point of a new world economic system. There is now a general desire to escape from a fiscal thraldom that has produced everywhere an industrial stalemate. How to get away from that thraldom and arrange a system of exchanges which will take into account differences in industrial conditions as regards wages, production costs, standards of living, and other factors, is a problem that does not admit of easy solution. The British policy of dealing first with countries that have thrown in their lot with sterling is the most likely to give definite and permanent results. With other countries negotiations are complicated by a mass of difficulties that make them particularly arduous. This provides an explanation of the delay in negotiating with France, which may be regarded as a pivot for dealing with countries outside the sterling group, and a commercial treaty with our neighbours is of great importance in completing the organisation which is essential to a return of industrial activity. The suggestion of the Federation of British Industries that the Government should not enter into commercial negotiations with the French Government until the super-tax of 15 per cent. imposed on goods from countries with depreciated currencies is removed is deprecated in France on the ground that the super-tax is not of a discriminating character, and that there is nothing in the measures adopted by the French to justify the reproach that Great Britain has not received most-favoured-nation treatment. The French reasoning is not convincing and is largely specious. Indirect means of raising import duties against goods from particular countries are undeniably contrary to the terms and the spirit of existing commercial treaties.

Alike in this country and in France it is recognised that commercial treaties must be established on an entirely new basis. When France officially denounced her treaties in 1918 on the understanding that they were to be continued by tacit agreement until some more acceptable arrangement could be reached, the French showed their intention to repudiate the most-favoured-nation treatment clause and obtain their freedom to accord what treatment they pleased to individual countries. So far as Great Britain is concerned the most-favoured-nation clause has been a delusion. It meant that when France made concessions to a highly protectionist country in return for advantages, those concessions were automatically granted to Great Britain, which was the only country to import French goods free of duty, and, for the

competitive sale of products in France, British firms derived no advantage whatever from this favour. In the same way, when France raised tariffs against foreign goods which threatened her own industry, British manufacturers of the same class of goods were gratified with a similar advance under the most-favoured-nation clause! There have been many such anomalies to the detriment of British trade. It will be remembered that when the Argentine Republic offered lower duties on British goods, after the successful exhibition of British manufactures and products organised in that country, the concession had to be abandoned because France claimed the same privilege under the most-favoured-nation clause. The system is not favourable to a reduction of tariffs, which is only possible when countries that lower tariffs can obtain equivalent treatment. Another serious drawback to the present system is the indirect raising of tariffs by means of accessory taxes and charges. The danger of these improvisations in tariff adjustments is recognised. It removes all sense of security in foreign trade, without which there can be no expansion of industrial and commercial activity. The difficulties in the way of carrying out commercial agreements are observable in the variety of methods that are suggested for conciliating the interests of manufacturers in different countries. The economic evolution of Europe is accompanied by so many changes that it is almost impossible to settle upon a definite method of organisation. The experts at Geneva have prepared a programme for the forthcoming World Economic Conference which appeals to everyone who believes that the future lies in a removal of trade barriers and in a complete freedom for international exchanges. The Conference may do something to reduce and consolidate tariffs, for every country is now convinced that they have disastrous effects upon all phases of industry and commerce, but as a suppression of tariffs would involve the extinction of many industries abroad the application of a complete Free Trade policy appears to be a remote contingency. It could only be possible in the event of all countries producing under identical conditions. If the Conference is to obtain even partial success there must be a gradual reduction of tariffs and a return to normal competition, which will necessarily eliminate foreign industries that have been developed under cover of protection for strictly national needs. Foreign economists are agreed that such industries must be sacrificed in the general interest. This will not be done without strong opposition from organised groups of manufacturers. If they cannot exist in face of foreign competition, with moderate tariffs to adjust any disparity in production costs, they will have to disappear, and industry will return to conditions that existed before Continental countries embarked upon the policy of producing everything themselves with the idea of becoming self-supporting. That appears to be the only way out of the present industrial dilemma. If there is to be no fair competitive trading the Conference will fail in its main objects.

In any case, it can hardly be expected that an organisation so vast as that indicated by the experts can be carried through in the near future. The world cannot wait for an organisation which, in the end, must necessarily be in the nature of a compromise. The French believe that there are only two ways of relieving the situation until such time as a permanent organisation can be established. The policy of reciprocal exchanges known as "compensating conventions" has been adopted in some cases whereby France agrees to purchase goods from countries that will take French goods of equal value. Another method is to leave groups of manufacturers to arrange with similar groups in other countries for an exchange of products. That implies an extension of the quota system, which has already been carried too far and will be abandoned as soon as it can be replaced by some more practical arrangement. Nevertheless, it is believed that much can be done by a close intercourse between groups of industrialists in different countries. Unhappily, so far as the final solution is concerned, the desire of some Continental countries to develop the whole range of industrial production, with the idea that it is necessary to national defence in a troubled world, greatly complicates the problems that will have to be discussed in future negotiations. The way to a solution is being prepared by the British Chamber of Commerce in Paris and the French Chamber of Commerce in London, which are endeavouring to conciliate the commercial and industrial interests of the two countries in view of negotiations for a treaty which, it is hoped, will be initiated at an early date

The Royal Society's Mond Laboratory.

ON Friday last, February 3rd, the new Royal Society Mond Laboratory, built in consequence of a bequest from that body to provide a home for the researches of Professor P. Kapitza, was opened by the Chancellor of Cambridge University, Mr. Stanley Baldwin. Hitherto, researches devoted to the study of the influence of very strong magnetic fields and very low temperatures on solids have been carried out in the original Cavendish Laboratory, but it was evident that better accommodation was necessary. In 1930, thanks to a new grant from the Department of Scientific and Industrial Research, a liquid hydrogen plant was constructed and plans were prepared for the production of still lower temperatures by a liquid helium plant which is to be constructed during the present year. With the completion of the liquid hydrogen equipment cryogenic work was taken up again in this country for the first time since the experiments of Dewar. For the first three years accommodation for these experiments was provided by Sir William Pope on the site occupied by the old steam laboratory built by Professor Ewing. But, as this site had been set aside for the future development of the chemical laboratories, a Royal Society's grant of £15,000 for the building and equipment of the new laboratory, with provision for alternative accommodation for other work and the clearing away of the old workshops from the courtyard of the Cavendish Laboratory, proved highly acceptable.

The new structure has been designed for the most part as a single block, with a group of first-floor rooms for offices at the end, and special care has been taken to separate the research rooms from the heavy machinery. The main hall—see Figs. 1 and 4—contains the alternator—Fig. 2—which provides the currents for the intense magnetic fields and its auxiliary apparatus. Near the alternator there is a machine room—Fig. 5—a workshop, and liquid air room, this section of the building being isolated structurally from the end of the building used for research by a gap of 3in. The roofs of the two sections of the laboratory overlap, and lead aprons, a mortar joint filling, lightly nailed battens, and two insulating pads join them. In order to allow partitions between research rooms to be removed the building is steel-framed, but the continuity of the frame is interrupted by reinforced concrete sections to minimise the transmission of vibration. Particular care has also been taken to reduce the intensity of the noise and vibration produced by the machines. All heavy machines are mounted on massive concrete foundations resting on a felt absorbent, while the walls and ceiling of the liquid air room, machine room, and workshop are covered with ½in. of asbestos spray absorbent, and most rooms have heavy sound-proof doors, which shut against rubber strips.

The liquid hydrogen and helium room has a special light, wooden roof, and a number of shutters which are released automatically in the event of any appreciable leak of hydrogen. During the liquefaction process hydrogen and helium are to be stored in large steel hollow forgings at a pressure of 10 atmospheres, and special automatic pumping machinery will pass the low-pressure gas from the liquefier back to the storage system, thus eliminating cumbersome gasholders with constant leakage of air. The hydrogen liquefier was constructed in the laboratory, and has an output of 5 litres per hour.

The liquid nitrogen plant has been thoroughly modernised by the installation of a new Reavell compressor, and a new purification plant and expansion engine have been presented by Dr. Heylandt.

Each of the six research rooms has large plate-glass windows with dark blinds. The walls are composed of plain distempered brick with vertical battens, spaced at intervals of 2ft. 6in., to provide fixings for apparatus. Panel radiators are attached to the ceilings to economise floor space, and the temperature of each room is controlled by thermostatic relays on the radiators. A switchboard in each room is designed to give a 220-volt battery supply, a three-wire D.C. supply, a four-wire A.C. supply, and leads can be connected to any desired terminals on a 100-volt battery. An overhead grid allows leads to be conveniently taken from the switchboard to any point in the room. To provide the heavy currents for magnets a central switchboard allows any one of five generators—Fig. 5—to be connected to any research room. A master clock, fitted with synchronous and pendulum controlled dials, distributes seconds impulses to the rooms, and enables the synchronous clocks in the rooms to be adjusted from the master clock should a failure of supply occur. In the corner of each research room there is a concrete galvanometer foundation which extends down to a depth of 10ft., and heavy copper earth rods have been provided with a view to securing that independence of electrical disturbances which is so desirable for magnetic work. The rooms on the first floor include a spectrograph room, with the walls painted black; the director's room; an office, and a large room which is used as a library, instrument store, balance room, drawing-office, and meeting room. The flat roofs are composed of precast concrete slabs, covered with Macasfelt, which has been washed over with lime and coarse sand to give as much radiation as possible. The architect for the buildings was Mr. H. C. Hughes, and the contractors Rattee and Kent, Ltd., of Cambridge.

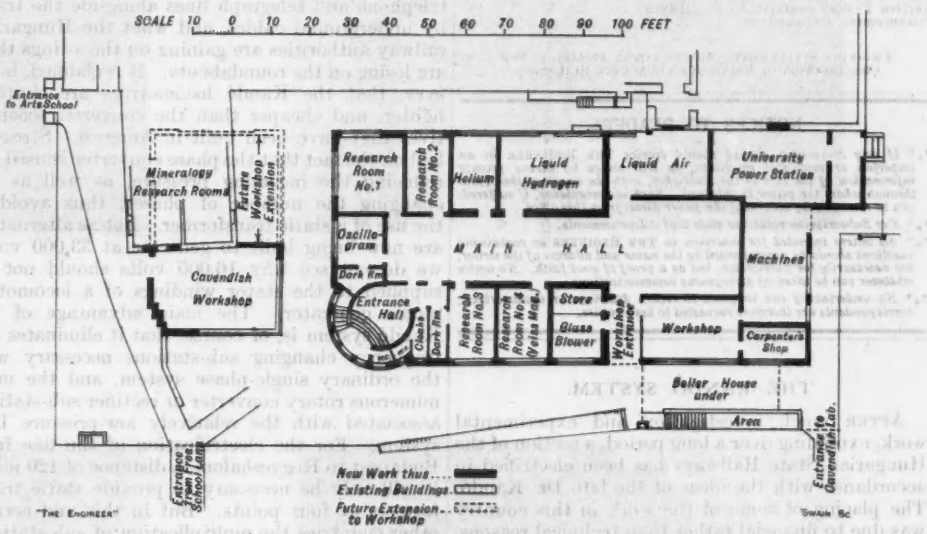


FIG. 1—PLAN OF LABORATORY

As regards the researches, it is well known that at a temperature approaching absolute zero many metals and alloys show an enormous and sudden increase in electrical conductivity, and at the same temperatures, salts which are generally only feebly magnetic begin to show large magnetisations in strong fields. The changes of length shown by many metals under the combination of low temperatures and strong fields seem likely to throw considerable light on the nature of the structure of solids. The importance of experiments combining the effects of strong fields and low temperatures is therefore clear. But the fields required for this work are far stronger than those that can be obtained from any ordinary electromagnet. The intensity of field which can be obtained from a magnet increases only logarithmically with the size. Even the largest magnet in existence, namely, that of the Academy of Sciences in Paris, which weighs several hundred tons, cannot produce fields much greater than 60,000 gauss. To obtain stronger fields it is necessary to resort to the comparatively simple method of passing a large current through a small coil. In this case the field obtainable varies as the square root of the power dissipated in the coil and inversely as the square root of the inner radius of the coil. Thus, if 30,000 kW are dissipated in a coil of 1 cm. internal diameter it is possible to obtain a field of 350,000 gauss. As, however, it is impossible to remove the heat generated by 30,000 kW continuously, it is necessary to interrupt the experiment when the temperature of the coil has risen above 100 deg. Cent., or in a period of about one-fiftieth of a second.

In the experiments of Professor Kapitza, the large powers necessary are obtained by taking advantage of the well-known property possessed by an alternat-

NEW RESEARCH LABORATORY AT CAMBRIDGE UNIVERSITY

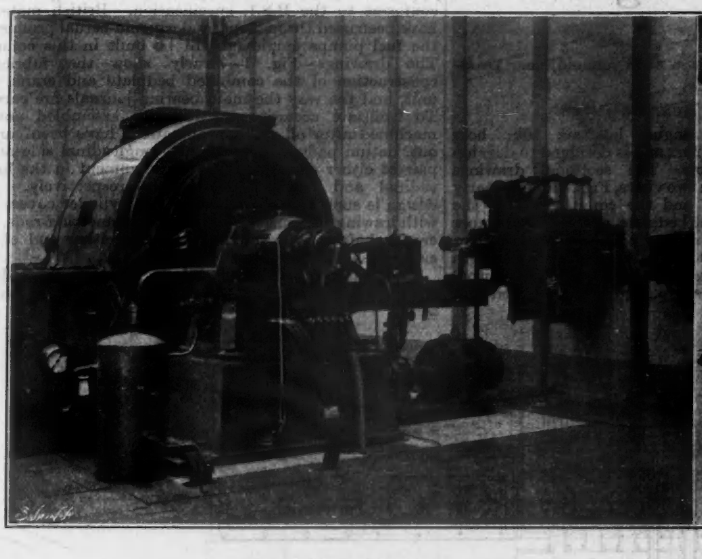


FIG. 2—ALTERNATOR

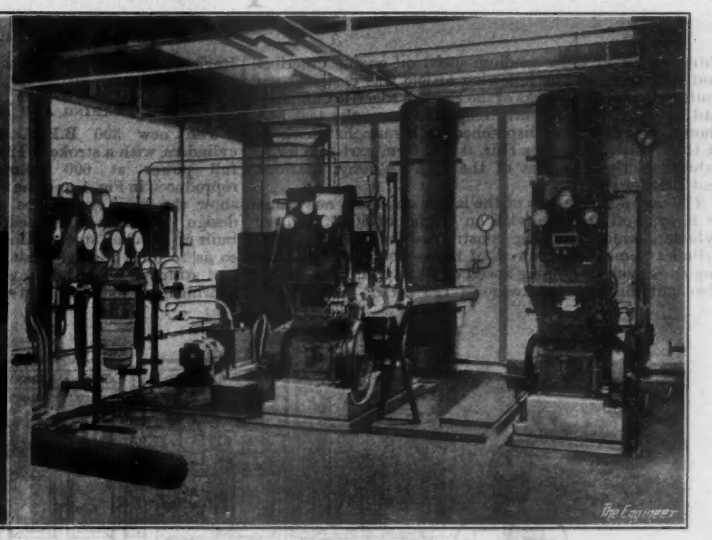


FIG. 3—LIQUID HYDROGEN PLANT

FIG. 4—MAIN HALL OF LABORATORY

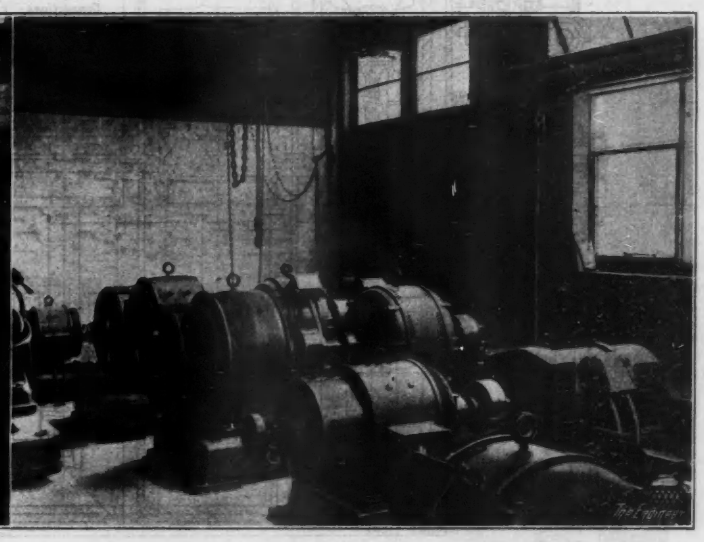


FIG. 5—MACHINE ROOM

ing current generator of producing a current on short circuit, for the first few cycles, of ten to twenty times the normal steady output of the machine. A generator —Fig. 2—of specially low impedance was therefore constructed by the Metropolitan-Vickers Electrical Company in 1925, which gives a peak current of 20,000 ampères at 2000 volts when connected to a coil of equal impedance, an automatic switch driven by a cam being arranged to make the circuit at zero voltage and to interrupt the current after one half cycle, exactly at the point of zero current. The timing of the switch can be adjusted to one ten-thousandth of a second, and has solved the difficult problem of interrupting large powers.

Another troublesome problem met with in the work was that of constructing a stable coil. The interaction of a magnetic field of 3,000,000 gauss with a current of 20,000 ampères produces a force in the neighbourhood of half a ton per cm. length of conductor, and as a result the pressures in the material of the coil rises far beyond the normal ultimate strength of copper. But the difficulty was ultimately overcome by using the high-tensile, high-conductivity cadmium-copper alloys recently developed for trolley cables, by impregnating the coils with bakelite, and by reinforcing the whole coil by many turns of high-tensile steel tape. If at a later date it is desired to produce still higher fields, it is not improbable that the limit will be set by the impossibility of finding material of the necessary conductivity and which possesses a sufficiently high tensile strength.

The production of low temperatures will be carried out in three stages by the liquefaction of nitrogen, hydrogen, and helium. Liquid nitrogen has a temperature of —196 deg. Cent., and by evaporating at reduced pressures temperatures of —210 deg. Cent. can be obtained. To secure still lower temperatures, hydrogen is liquefied and gives a temperature of —253 deg. Cent.; whilst by evaporating at low pressures the temperature may be reduced 6 deg. still lower to within 14 deg. of absolute zero. Hydrogen liquefaction is carried out by compressing the gas to 170 atmospheres and by making use of the Joule-Thompson cooling effect on expansion to atmospheric pressure. Unless, however, the temperature before expansion is already sufficiently low, hydrogen expansion gives a heating effect, and it is therefore necessary to use liquid nitrogen evaporating at reduced pressure to pre-cool the stream of compressed hydrogen to about —207 deg. Cent., and then to pass the hydrogen into a regenerator spiral, in which it is further cooled by the return flow of the expanded gases, expansion taking place to atmospheric pressure at the end of the spiral. The liquefaction of helium is a still more complicated process. It is compressed to 40 atmospheres, and then after pre-cooling and passing through a regenerator spiral, it is expanded, but in order to obtain cooling on expansion it is necessary to pre-cool to extremely low temperatures, and only liquid hydrogen can be used for this purpose, and it is therefore necessary to have an ample supply of that element. A view of the liquid hydrogen plant is given in Fig. 3.

SIXTY YEARS AGO.

FROM our issues of January 31st and February 7th, 1873, and from a few scattered references in succeeding numbers, it is possible to piece together most of the details of a marine disaster which seems now to have faded almost completely into the background of history. It was a disaster doubly tragic because it was so wholly unnecessary. All the facts concerning it cannot be precisely stated, partly because we were content to comment upon them rather than to record them; partly because other sources of information which we have consulted have, for once, failed us, and partly because there seems to have been a genuine element of mystery and uncertainty about some of the circumstances. . . . The "Northfleet" was an emigrant ship about to sail to the Antipodes. One night, during the last week of January, 1873, she was lying at anchor off Dover Harbour, close to the shore. She had on board some hundreds of passengers and was commanded by Captain Knowles, who had been appointed to her only a few days previously. It may have been a very rough night—the winter had been one of the stormiest on record—or it may have been calm and misty; but, suddenly, she was struck by a steamer which, having torn a hole in her hull, immediately backed away and left her to her fate. The identity of the steamer was not known at the time, and, apparently, remained in doubt for some days. In our issue of February 14th, 1873, we find a note reporting the belief that she was the Clyde-built steamer "Murillo," engaged in the British-Spanish trade. The stricken "Northfleet," rapidly sinking within easy reach of help from the shore and surrounding vessels, fired rockets and blue lights, but if they were seen, as they undoubtedly were from the shore at least, they were not interpreted as signals of distress. Had a gun been fired in addition, there would have been little doubt that help was needed urgently. The "Northfleet" had a signal gun. It was loaded ready for just such an emergency, but when it was sought to fire it, it was found that the vent had been stopped with white lead which had hardened and could not be removed. The ship sank and carried three hundred people to their end. Some tried to save themselves by the ship's boats, but the tragedy was heightened by the fact that in two of these boats the plug holes were unstopped. There was, in those days, no accepted signal of distress for the use of ships. Rockets and blue lights might mean anything; they might indicate that a ship desired a pilot or merely wished to attract attention to her presence. Indeed, the pilot at Dover saw the "Northfleet's" signals, but it was not until he witnessed the unusual spectacle of six blue lights burning simultaneously on her deck that he surmised something serious might have happened and took steps to investigate it. We urged with all the power at our command that a standard system of distress signals should be devised and enforced by law on all British ships. We denied the contention of critics that it would be impossible to prescribe any system that would not be capable of being misunderstood or of being abused. We argued, too, in favour of the compulsory provision of cork rafts on all emigrant ships, and only because it was more a legal than an engineering subject did we refrain from insisting upon the provision of a law to govern the conduct of a ship after she had run down another. For the time being our pleas were largely to fall on deaf ears, but soon Plimsoll was to begin his campaign against the still more crying evil represented by the overloading of ships and with its ultimate success, in spite of the vehement opposition of numerous opponents, the general safety of ships at sea came to be recognised as a subject over which the Government should exercise strict control.

THE Canadian Carborundum Company, Ltd., has completed and brought into operation a 250,000-dollar extension to the Niagara Falls, Ontario, plant. Most of the machinery installed in the new plant was manufactured in Canada.

New Medium Speed Oil Engine.

THE new six-cylinder medium-speed oil engine described and illustrated in the following article was designed and built at the Willans works of the English Electric Company, Ltd., Rugby. We recently inspected it on the test bed, shortly before it was dispatched to Birmingham, where, at the British Industries Fair, it will form part of a larger exhibit of the products of the firm's Rugby, Stafford, and Bradford works.

The new design is one of the larger units in a new range of K type oil engines, with an output of 50 B.H.P. per cylinder, which is being constructed in three to eight cylinders, embracing powers of 150 to 400 B.H.P., all the engines having a running speed of 600 r.p.m. The firm is also building a similar range of 125 B.H.P. per cylinder Regional Broadcasting Station at Wychbold, near Droitwich.

FRAMING AND RUNNING PARTS.

The new 300 B.H.P. engine has six 10in. bore cylinders, with a stroke of 12in., and is designed to develop full power at 600 r.p.m. The sectional drawings reproduced in Fig. 1, and the two views, Figs. 4 and 5, clearly show the very clean lines and the compactness of the design. It has a combined bedplate and crank chamber built up of rolled steel sections and plates welded together, so as to form a single unit, with the necessary strength and stiffness. The housings for the crank shaft journal bearings are made of cast steel, and are registered and structural strength of both the framing and the principal running parts is in accordance with the requirements of Lloyd's Register of Shipping, and the design has been approved by that authority, whilst the engine rating conforms to the B.S.I. specification. British materials have been used throughout, and when in actual production the fuel pumps employed will be built in this country. The drawings—Fig. 1—clearly show the fabricated construction of the combined bedplate and crank case unit, and the way the main bearing journals are carried. To facilitate accurate erection, the assembled unit is machined after all welding operations have been carried out, datum pads, a pair on each longitudinal side and a pair at either end, providing for alignment in the longitudinal and transverse directions respectively. The design is such that by taking off the cylinder covers and withdrawing the pistons with their connecting-rods, the crank shaft can be removed through either end of the crank case.

The crank shaft is forged from the highest grade of bloom in one piece, and carries a solid flange for the fly-

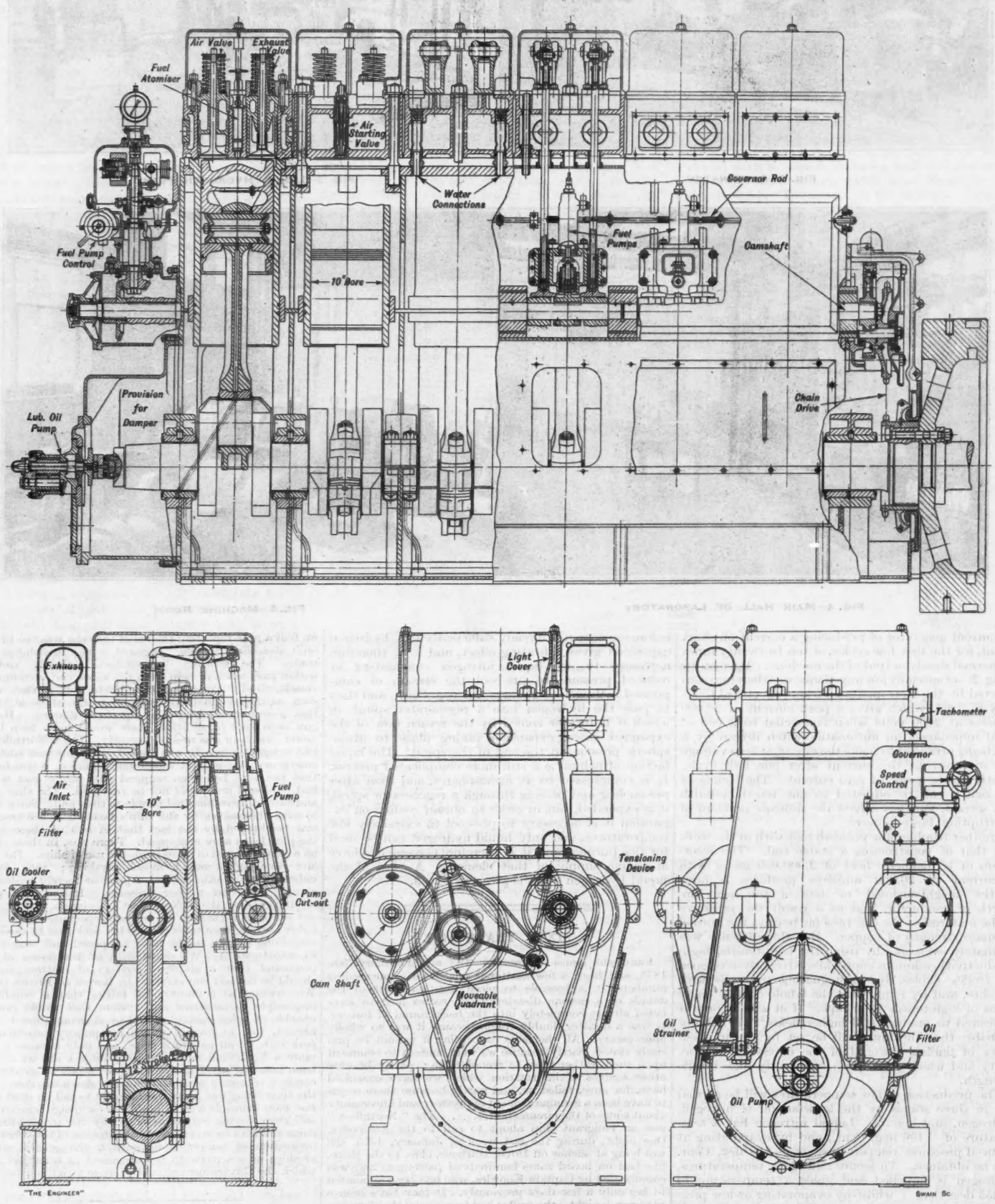


FIG. 1—CROSS AND LONGITUDINAL SECTIONS AND OTHER DETAILS OF 300 B.H.P. OIL ENGINE

"L" type engines, giving outputs of 375 up to 1000 B.H.P. at 375 r.p.m. During our visit to Rugby we saw parts going through the shops for four 750 B.H.P. engines of this type, which are being supplied for the new Midland welded to the lower transverse members of the bedplate. The engine is completely enclosed, but access to the principal parts is given by large-sized inspection doors, which are light and can be conveniently handled. The wheel, and a tapered and screwed portion at the opposite end, for the attachment of a damping device, should operating conditions call for the fitting of such equipment, in order to meet critical speed conditions other

than those in the engine itself, which, it is claimed, is free from critical speeds and harmful torsional vibrations. The main bearing shells are made of steel with white-metal lining. Stampings of 35 tons Siemens-Martin steel are employed for the connecting-rods, which also have white-metal-lined bottom ends. A feature of the bottom end design is the provision of two small bolts at opposite corners, which are used to fasten together the upper and lower shells, and make them one unit, even after the bottom end bolts have been withdrawn for dismantling or during erection. The top end bearing is of phosphor bronze.

The cylinder liners are made of special cast iron mixture, the bores being finished by honing. Allowance is made for the expansion and contraction of the liners by fixing them at the upper end only, the water joint at the lower end of the liner being made by two oil and heat-resisting rubber rings.

The pistons have deeply dished crowns, and are made of special heat-resisting iron. A floating gudgeon pin is used and provision is made for its lubrication over the whole length of the pin.

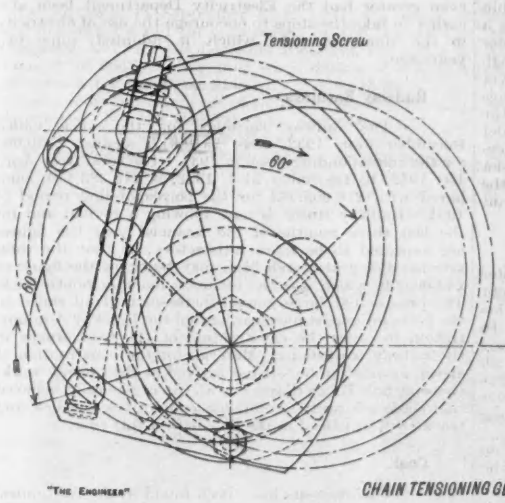
The pistons are designed with a special system of graduated clearances, which experience has shown gives the maximum transference of heat with minimum friction. There are three pressure rings, and one scraper ring below the gudgeon pin, the top ring being placed at a distance of a quarter of the cylinder bore down from top edge of piston in order to allow efficient lubrication and freedom from sticking.

Cylinder Covers and Valve Gear.

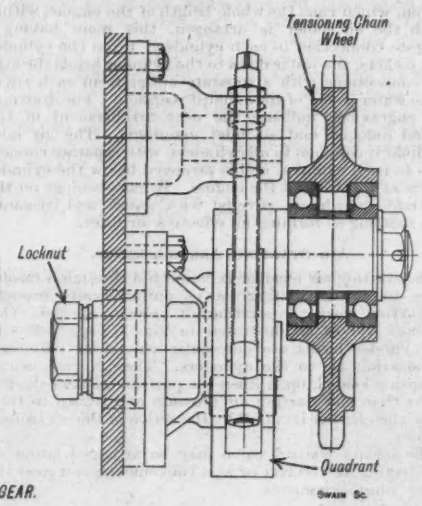
As will be seen from the drawings and from Fig. 7, a square design of cylinder head has been chosen. It carries the machined seatings for the air inlet and exhaust valves, and also the fuel atomiser or injector, and the air starting valves on such cylinders as are used for starting. The cover castings are of special heat-resisting cast iron, and particular care has been taken in their design to secure absence of vapour pockets by giving unobstructed circulation of cooling water. The water connections to the liner spaces are made with internal tubes. Removable plugs for cleaning are provided.

The whole of the valve gear is enclosed by a light removable cover, which gives access to the fuel piping, fuel injector, and rocker gear. Each valve has a separate cage, and the air and exhaust valves have long guides, and are operated by push-rods through rocker gear carried on the top of the cover, which is so arranged that it can be removed complete with the valves. The exhaust valves are made of specially high-grade heat-resisting steel. The top ends of the valves are hardened, as are also the tappet ends of the valve rockers. Two springs are provided on each valve in order to reduce to a minimum the risk of valve failure.

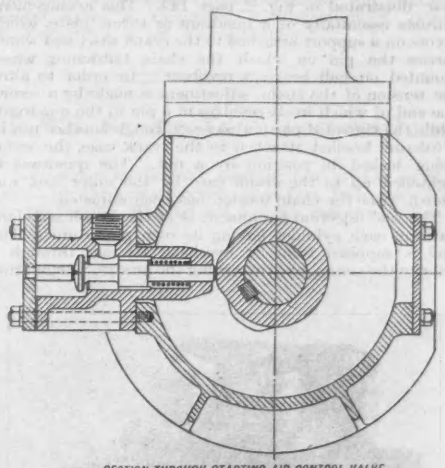
Both the fuel injection and starting air valves are automatic in action, and are opened by the pressure of the fuel and starting air respectively.



"The Engineer" CHAIN TENSIONING GEAR.



Swain Sc.



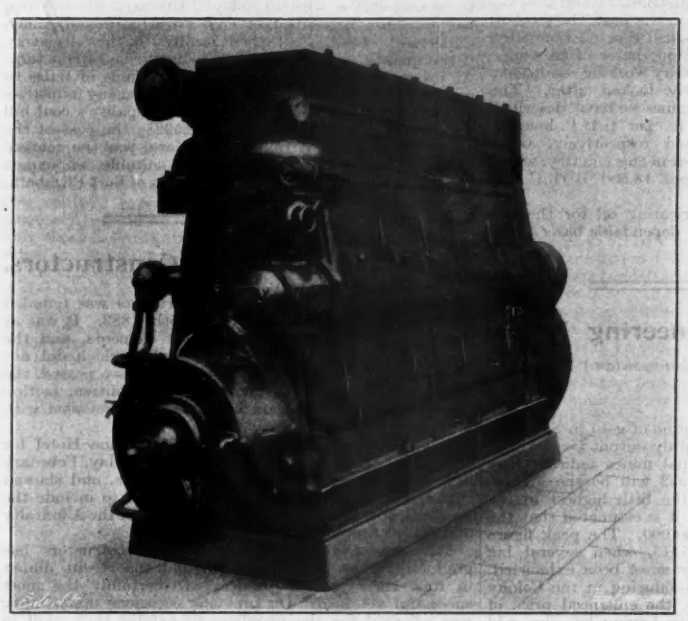
SECTION THROUGH STARTING AIR CONTROL VALVE.

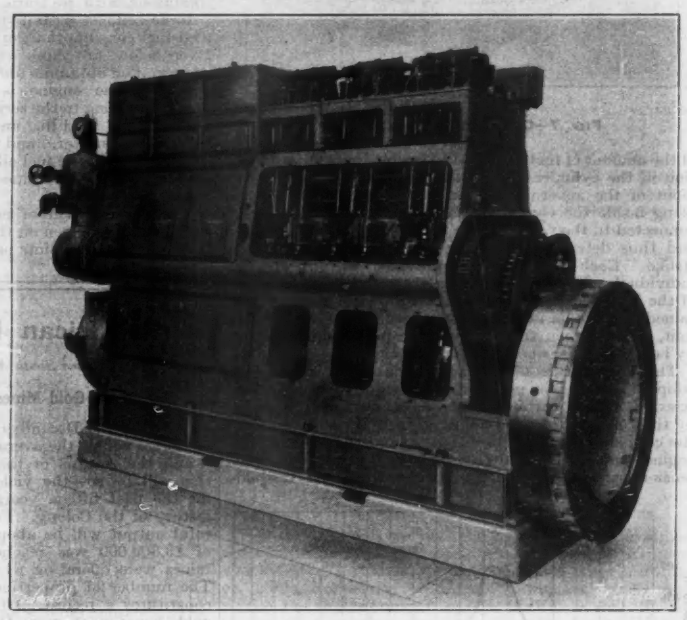
"The Engineer" Swain Sc.

FIGS. 2 AND 3—CHAIN TENSIONING GEAR AND STARTING AIR VALVE

complete cam shaft can be withdrawn through them. All the cams are of steel, and are case-hardened on the working face, while the fuel cams are removable without disturbing the cam shaft. The tips of the cams dip into an oil bath.

The cam shaft is driven from the crank shaft by means of a train of spur wheels at the flywheel end of the engine. The arrangement of the cam shaft and fuel pump units with the through-going push rods is shown in Fig. 6. The cam shaft is housed in a compartment formed in the side of the crank case, with a bearing between each set of cams. The bearings take the form of bronze bushed steel sleeves, which are so dimensioned that the





FIGS. 4 AND 5—GENERAL VIEWS OF 6-CYLINDER 300 B.H.P. OIL ENGINE

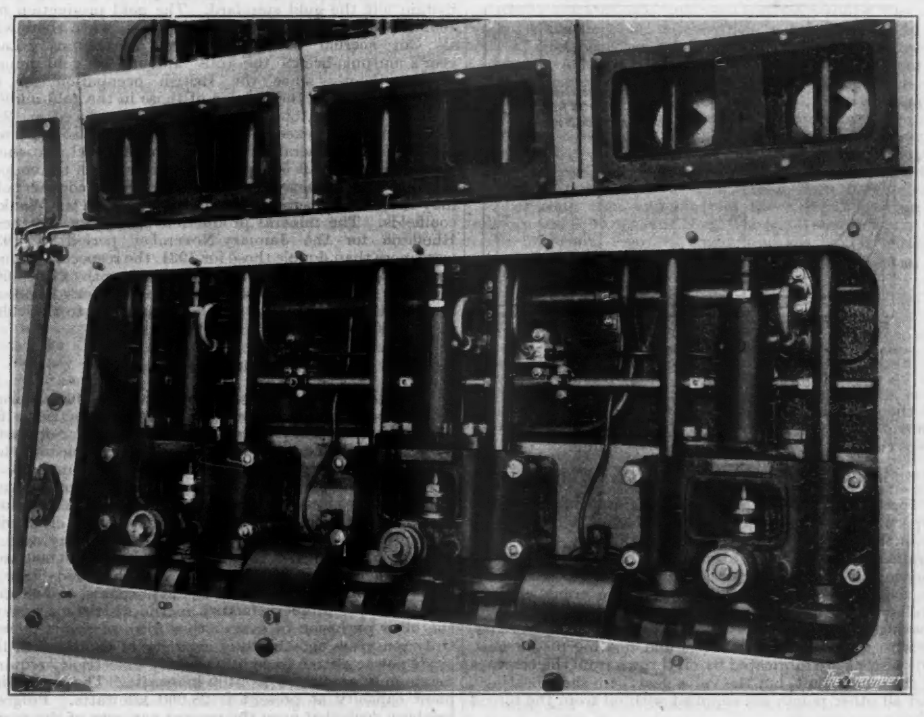


FIG. 6—CAM SHAFT AND FUEL PUMP ASSEMBLY

of a vertical chain drive and spur wheel reducing gear. The gearing is clearly shown in the view of the engine from the fly-wheel end, with the gear cover removed.

An interesting mechanical device is the chain tensioning gear, illustrated in Fig. 2, page 149. This arrangement consists essentially of a quadrant or throw plate, which pivots on a support attached to the crank case, and which carries the pin on which the chain tensioning wheel mounted on ball bearings revolves. In order to alter the tension of the chain, adjustment is made by a screw, one end of which freely revolves in a pin in the quadrant, while the threaded portion passes through another pin in a fulcrum bracket attached to the crank case, the screw being locked in position by a nut. The quadrant is tightened up to the crank case by the outer lock nut shown, after the chain tension has been adjusted.

The fuel injection equipment is of the Bosch standard pattern, each cylinder having its own pump unit. The fuel is supplied from an overhead strainer through a filter to the common main serving the pumps. Regulation

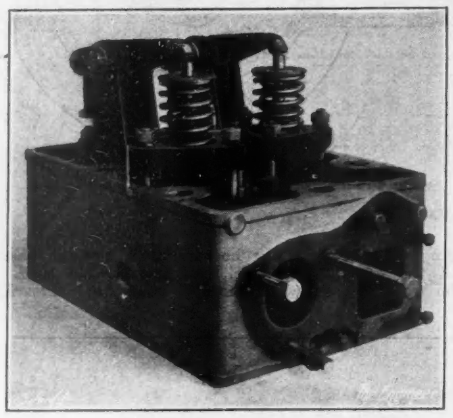


FIG. 7—CYLINDER COVER UNIT

of the amount of fuel delivered to the injectors for atomisation in the cylinders is effected by the horizontal movement of the governor rod or control shaft, which runs along inside the cam shaft compartment and is directly connected to the racks, which turn the fuel pump plunger and thus determine the quantity of fuel delivered per stroke. Each fuel pump is provided with means for individual adjustment so that the correct distribution of the load over all the cylinders can be accurately maintained. There is also a cut-out device, on each pump unit, which, when turned, puts the pump out of action by holding up the operating plunger clear of the fuel cam.

The governor is of the centrifugal type, the design adopted having been used for a number of years in various sizes of steam turbines and oil engines manufactured by the English Electric Company, Ltd. It is driven from the cam shaft through bevel gears, and the speed of the engine can readily be altered by varying the load on the tension spring provided for the purpose. At the side

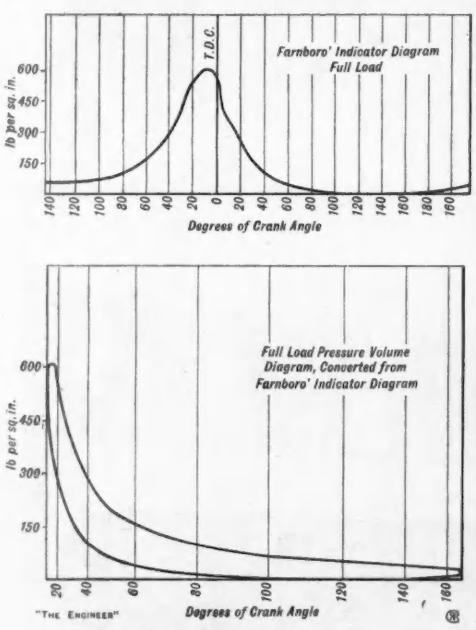


FIG. 8—INDICATOR DIAGRAMS

of the governor is a conveniently arranged fuel pump control gear, and above the governor a tachometer gives the speed at which the engine is running.

LUBRICATING AND WATER CIRCULATING SYSTEMS.

The supply of lubricating oil is maintained by a gear-type pump driven from the crank shaft. It lifts the oil from the sump tank and delivers it through a fine mesh strainer and an oil cooler attached to the side of the engine, thence to a bus pipe inside the crank case with connections to the crank shaft main bearings. The crank shaft is drilled to supply oil to the connecting-rod lower end bearings, from which it is led up through the connecting-rods to the small end bearings and floating piston pins. The pistons are lubricated by oil thrown from the bearings of the crank shaft, but the valve gear, cam shaft bearings, and all other points are supplied with oil from the forced lubrication system.

In order to maintain the oil in clean condition, a small portion of it is by-passed from the pressure system after the strainer, through an oil filter of felt, back to the sump tank.

The jacket cooling water flows through a pipe of large section, which runs the whole length of the engine, within which the oil cooler is arranged, this main having a separate connection to each cylinder. From the cylinder liner jackets, the water flows to the cylinder heads through two connections with a separate outlet from each cover to the water jacket of the exhaust manifold. The drawings and engravings indicate the neat arrangement of the welded exhaust and air inlet manifolds. The air inlet manifold is common to all cylinders, with separate connections to each cylinder, and is arranged below the cylinder covers at the back of the engine. It has openings on the underside which are covered with gauze and cocoanut fibre matting so forming an effective air filter.

AIR STARTING ARRANGEMENTS.

The starting air receiver is connected through a master valve to air-distributing valves automatically brought into action when the starting air valve is opened. One of these valves is illustrated in Fig. 3, page 149. In the cylinder heads are automatic valves for admitting the starting air to the cylinders. These valves, which are spring-loaded, open when the pressure in the cylinders is less than the starting air pressure and return to their seats when the air is cut off by the action of the controlling valves.

The master control valve may be arranged either on the starting air receiver or at a convenient point near the engine running controls.

PERFORMANCE AND OIL CONSUMPTION.

The full-load "Farnboro" indicator diagram and the pressure volume diagram derived from it, which we reproduce below, clearly show the smooth character of the combustion cycle, and the moderate maximum pressure attained. The engine was tested under all load conditions, with, we learn, very satisfactory results.

In accordance with its practice in the past, the guaranteed fuel consumptions of the English Electric Company, given below, are those which the purchaser of an engine can count on obtaining under ordinary working conditions, providing the engine is properly looked after. The figures applying to the series of engines we have described are 0·39 lb., 0·41 lb., and 0·44 lb. per B.H.P.-hour at full, three-quarter, and half-load respectively, using the ordinary Diesel fuel oil supplied in this country, which has a net calorific value of about 18,500 B.Th.U. per pound.

The consumption of new lubricating oil for the 300 B.H.P. engine, given on the same dependable basis as the fuel figures, is 1·2 pints per hour.

South African Engineering Notes.

(By our South African Correspondent.)

Rhodesian Gold Mines.

IF the December production of gold in Southern Rhodesia equals the average monthly output for the year —and the returns of the principal mines indicate that this will be so—the yield for 1932 will be the highest for the past fifteen years, and the fifth highest in the history of the Colony. For 1932 it is estimated that the total output will be about £3,300,000. The peak figure of £3,800,000 was reached in 1915, when several big mines were operating which have since been exhausted. The number of properties now producing in the Colony constitutes a record. Of course, the enhanced price of gold, consequent upon the Colony having left the gold standard in December, has been an important factor, but a more significant and encouraging feature is the number of new and highly promising mines which have been opened up. This is a direct result of the stimulus given to mining enterprises by the gold premium, and it is agreed that the Government took a wise step in the interests of the Colony in linking up with sterling when Britain left the gold standard. The gold production for 1932 is 33 per cent. greater than in 1931, when there was also an accrual of three months' premiums. Last year's output brings the total amount of gold mined in the Colony since the British occupation up to £80,000,000. It is the opinion of those in the gold-mining industry that the total amount of gold produced in 1933 will substantially exceed that of 1932. It is also expected that the base mineral output for the year will also show an advance, while it is hoped that a recovery of the copper market, and of activities in the northern copper belt, may lead to the resumption of normal work on the Wankie coalfields. The mineral production figures for Northern Rhodesia for the January-November period of 1932 were more than double those for 1931, the respective values being £2,345,000 for 1932, compared with £1,063,063 for 1931. Since mining was begun in Northern Rhodesia in 1906, the Territory has produced minerals to the value of £10,500,000.

Cape Town's Electricity Undertaking.

The great progress which has been made during recent years in Cape Town in the use of electricity for all purposes, and, in particular, more recently for domestic purposes, furnishes a remarkably fine example of what can be accomplished by a well-directed campaign of electrical development on the part of an enterprising and highly efficient electricity undertaking. Since its inauguration in 1895, for the purpose of supplying electricity for lighting in a restricted portion of the old city area, it has advanced to the position when it has 30,000 consumers, against 15,000 in 1923, and thousands take a supply of current for other domestic purposes, and electric power is used in every factory in the districts served to the utter exclusion of every other form of prime mover. Only ten years ago the total capacity of the plant in the city's power station to supply the city's electricity requirements only amounted to 9400 kilowatts. The generating plant capacity at present is 28,000 kilowatts. Progress has been such that even the present capacity of the power station is now too small for the city's needs, and an additional 20,000 kilowatts of generating plant has already been ordered. This, it is anticipated, will have to be further augmented after another two or three years. The achievements of the undertaking would have been even greater had the Electricity Department been able earlier to take the steps to encourage the use of electricity in the domestic field which it adopted some two years ago.

Railway Earnings.

The railway earnings for the week ended December 31st, 1932, were £340,917, against £380,099 for the corresponding week in 1931. The total from April 1st, 1932, to December 31st, 1932, is £15,383,440, compared with £16,905,942 for the corresponding period of 1931. Railway traffic is now showing a revival and for the last three months of the financial year the figures are expected to be more satisfactory, so that the total accrued deficit at March 31st, may be below the figure of £4,000,000, which was the estimate made a month back. The prospect of large annual increases in fruit railed to the ports for export overseas has led the Railway Administration to order the construction of 100 fruit trucks in the railway workshops. Material for the construction of eleven locomotive boilers has arrived at the railway workshops at Salt River (Cape Town). It is generally believed that some substantial orders for locomotives, coaches, and trucks will be placed in the first half of this year.

Coal.

Coal deposits have been found in the Alexandria district and about 55 miles from Port Elizabeth. The existence of coal had been noted by the Geological Survey a number of years ago. A syndicate in Holland was approached by the discoverers, and sent out a consulting economic geologist, and has definitely proved the existence of coal seams. The quality of the seams and their thickness will have to be determined by borings, which are to be undertaken without delay. Although South Africa has immense quantities of coal already proved, much importance will be attached locally to this discovery if the quality and quantity are found to be satisfactory. At present coal has to be brought hundreds of miles to supply the electrical power station and the many industries in Port Elizabeth. Last year the Municipality's coal bill for the electricity works came to £5328; the cost of the railage on bringing it round from Natal was the colossal sum of £27,352. If the quality is suitable, an export trade may be developed through the port of Port Elizabeth.

Royal Corps of Naval Constructors.

THE Royal Corps of Naval Constructors was founded by Order in Council, dated August 5th, 1883. It was at first a collection of very discordant elements, and the early years threatened a factional spirit which did not bode well for the Service. As the years have passed, the Corps has grown into a homogeneous condition, faction has disappeared, and good fellowship has prevailed with increasing effect.

A very influential gathering at Park Lane Hotel for the annual dinner of the Royal Corps on Friday, February 3rd, bore witness to this splendid progress, and showed that the spirit of fellowship had extended to include the good-will of members of every department of the Admiralty and Naval Services.

The annual dinner of the Naval Constructors has gradually grown in importance, and the recent dinner in this, their year of jubilee, was certainly the most successful yet held. On previous occasions opportunity was afforded for the members to exhibit their skill in literary, musical, humorous, and histrionic affairs, but, on this occasion, the time was occupied by some speeches of considerable practical and historical merit. The chairman, Sir Arthur W. Johns, opened well, and, after the toast of "H.M. The King" had been duly honoured, he proposed "The Board of Admiralty," giving an entertaining and informing historical account of the development of the Board to its present position. He mentioned that in 408 years there have been fifty-seven Controllers, but that the Secretary's office goes back at least 320 years more. The Controller of the Navy, Vice-Admiral C. M. Forbes, and the Secretary of the Admiralty, Sir Oswyn R. Murray, responded to the toast in eloquent terms. Each added piquant and humorous information as to his predecessors in office, each congratulated the chairman on the King's Honour announced last month, and each also bore record to the splendid work of the Royal Corps. Mr. R. W. Dana proposed "The Royal Corps of Naval Constructors," to which Mr. F. Bryant, Deputy Director of Naval Construction, responded.

The toast of "The Guests," proposed by Sir Eustace d'Eyncourt, was acknowledged by Commander C. W. Craven, who spoke on behalf of a very distinguished company of shipbuilders and engineers, Naval and civilian officers, and representatives of the United States and the Royal Italian Navies.

The final toast, that of "The Chairman," was proposed by the Director of Dockyards, Sir Percy Addison, and the chairman, in responding, expressed the great appreciation of the members of the Royal Corps for all the kind things which had been said, and pledged himself and the members to continue to devote themselves to the utmost to the great work in their hands.

The "past members" rallied well. The "father" of the Royal Corps, Mr. J. A. Yates, who finished his course at the Royal Naval College in 1875, was present, together with seventeen others, and a message of sympathy was sent to Mr. W. J. Luke, whose health did not permit him to attend. The Deputy Director of Dockyards, Mr. C. E. Goodyear, and many other Construction Officers of all ranks from the Admiralty, the Outports, and the Royal Dockyards, attended, and a message of good-will was received from the members at Malta. The eight Probationary Assistant Constructors now studying at the Royal Naval College, Greenwich, attended, making a total of 144 present, which included fifty-six official and private guests, eighteen past-members, and seventy members of various ranks now serving in the Royal Corps of Naval Constructors.

Bermuda Railway Motor Freight Locomotive.

IN our issue of September 25th, 1931, we described and illustrated a rail car constructed by the Drewry Car Company, Ltd., for the Bermuda Railways, and again in January of last year we gave some details of a freight locomotive for the same concern. Below, there is illustrated a more powerful type of freight locomotive recently despatched by the Drewry Car Company, Ltd., to Bermuda. It is equipped with two power bogies similar to those installed on previous locomotives and carrying Parsons M 8 engines and Wilson-Drewry five-speed preselective gear-boxes. The final drive to the axle is through inverted tooth silent chains. As will be seen from the engraving, the trailing and leading axles of each bogie are connected by coupling-rods. A driver's cab is provided at each end of the van and the controls are duplicated. The controls operate upon both power bogies simultaneously, and their arrangement only differs in detail from those described in our issue of September 25th, 1931. When pulling light loads, it is possible to "cut out" one engine and utilise the other alone. The general dimensions of this freight locomotive are given in the following table :

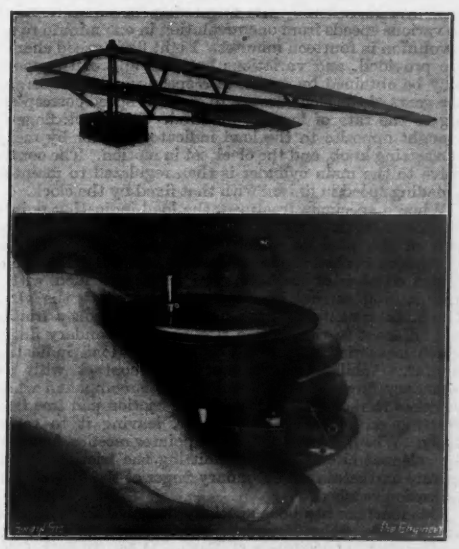
Gauge	4ft. 8½in.
Length over headstocks	42ft. approx.
Width	8ft. 6in.
Height	11ft.
Rigid wheel base	7ft.
Bogie centres	20ft. 6in. approx.
Weight fully loaded	34 tons

MOTOR FREIGHT LOCOMOTIVE

SADDLE TANK LOCOMOTIVE

The Heston Air Port Clock.

A NOVEL clock for a somewhat unusual purpose is now to be seen at Heston Air Port, Hounslow, where an electrically driven timepiece with a horizontal dial 14ft. in diameter has recently been installed. It represents what is believed to be the first attempt to give the time from the ground to aeroplanes while in flight. It is also notable as being the largest clock yet in operation driven by synchronous electric motors running in step with the A.C. supply mains. The construction of the clock presented a number of unusual difficulties, the chief amongst them being the leverage exerted by the long overhang of the hands and the heavy downward thrust due to the weight of hands and spindles.



AIR PORT CLOCK, HANDS AND MOTOR

The use of the synchronous motor drive was decided upon owing to the great power which could be obtained and the small space which the motors and reduction gear occupy. Thus, although the hands are equal in size to those of many a large tower clock, the casing of the motors, &c., only measures 15in. by 8in. by 6in. This gives a good idea of the compactness obtained with the synchronous motor drive.

The dial is of cement, and is provided with a raised circle around the circumference which carries the hour figures. At the point where the figure 12 appears the circle is increased in width in order to enable the time to be more easily discerned from the air. At the centre of the dial is a concrete foundation, in which are set the bolts which secure the driving unit in place. The sunk centre portion of the dial is given a slight slope towards the edge, and the upstanding figure circle is provided with drain holes which prevent rain water from accumulating on the dial.

The hands are designed to be as dissimilar as possible, with the object of preventing confusion between them. They are built on the cantilever principle, being provided with tie bars of girder construction on the underside. The counterbalancing has to some extent been provided for by a portion projecting from the spindles in a diametrically opposite direction to that of the hands proper. The vertical thrust of the hands is borne by a specially designed pair of ball races of "foot-step" type, these being so constructed that the weight of the hour and minute hands is dealt with quite independently.

The drive is by two "C" type Synclock motors, each of which has its own independent reduction gearing encased in a sealed oil bath. The speed of the final spindles of these motors is 1 r.p.m., and the further 60 to 1 reduction necessary to drive the hands is obtained by the use of normal wheel and pinion reduction gear.

It was found necessary to run the motors with their rotor and other spindles in a horizontal position, and in order to change the plane of the drive a spiral bevel gear was introduced at the final stage. Each of the motors develops 0·8 inch-pounds, a total of 1·6 inch-pounds being therefore available. The makers found this to be more than sufficient to drive the hands through all weathers.

The outer casing which protects the driving unit has been specially designed to render it weatherproof, particular care being given to the point where the hands' spindles emerge, in order to prevent water from entering. To ensure the maximum visibility the scheme chosen for the dial consists of a dark groundwork with figures and hands in white.

The design of the figures used was the result of careful selection, and Arabic numerals of a particularly distinctive type were finally decided upon. Twelve divisions only appear around the edge of the dial, the usual minute marks being omitted.

The current for the motors is drawn from the normal supply mains of the aerodrome, and as the timekeeping of the clock is controlled by the frequency of the current itself, there is no master clock or battery. Under these circumstances the clock is entirely self-maintaining and requires no attention from the ground staff. The clock was constructed by Synclocks, Ltd., throughout at their Colindale works.

Engineering in Japan.

THE twenty-fifth anniversary of the death of an engineer who was influential in laying the foundations of modern engineering in Japan was observed by the Alumni Club of Tokio Imperial University on the evening of January 10th, when a notable company gathered to do honour to the memory of Professor Charles Dickenson West, M.A., C.E., who for a quarter of a century was in charge of the Department of Mechanical and Marine Engineering of the University. Earlier in the day the Committee in a body visited the grave of Mr. West in Aoyama Cemetery, and paid reverence to the soul of their former teacher, placing wreaths about the tomb. The President of the Imperial University, Dr. Kiheiji Onozuka, spoke on the late Professor's career and service. Mr. West graduated at Dublin University and Trinity College, and while serving as chief designer at Birkenhead shipyard, was called to Japan, in 1882, to take charge of what was then the Imperial College of Engineering—newly established. In 1886 this institution became a department of the first Imperial University, that of Tokio, and Mr. West remained senior professor until his sudden death in 1908. In this period, hundreds of students passed through his hands. On his death the West Scholarship was founded by a generous gift from his sister, Mrs. Dowden, and a bust, the gift of friends and former pupils, adorns the University grounds. Other speakers were Dr. Bunji Mano, member of the House of Peers and Professor Emeritus of the Tokio and Kiushu Imperial Universities, and the British Ambassador (Sir Francis Lindley). In addition to Dr. Mano, among old pupils who have achieved distinction were Baron Chuzaburo Shiba, and Professors Masao Kamo, S. Uchimaru, K. Takemura, S. Tamba, K. Yokoyama, and F. Yamanouchi.

L.M.S. Saddle Tank Locomotives.

FIVE 0–4–0 saddle tank shunting locomotives, as illustrated by the accompanying engraving, have been built for the London, Midland and Scottish Railway by Kitson and Co., Ltd., Airedale Foundry, Leeds, to the design of the chief mechanical engineer, L.M.S.R. These engines are required for shunting purposes only. The leading dimensions and particulars of the locomotives are as follows :—

Working steam pressure	160 lb. per sq. in. (saturated)
Cylinders	Two outside, 15½in. dia. by 20in. stroke
Tractive effort	14,200 lb.
Coupled wheels	3ft. 10in. dia.
Grate area	11·75 sq. ft.
Coal capacity	1 ton
Water capacity	800 gallons
Total weight in working order	33 tons

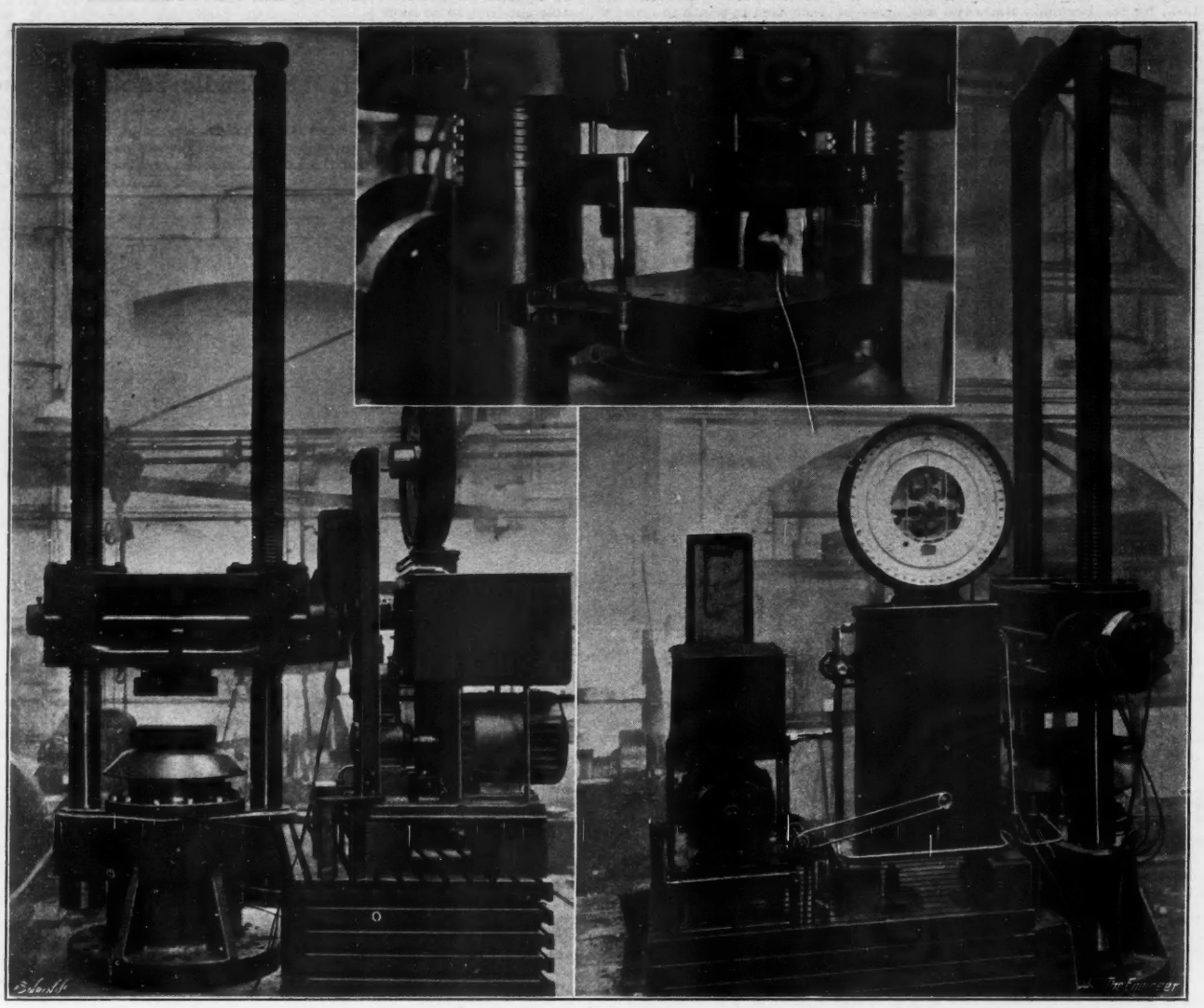
Keenol Lubricant.

A FEW days ago we had the opportunity to examine the various dismembered parts of a "Rover" 8 H.P. car, which had been running for the last 33,000 miles of a total of 40,000, exclusively on Keenol lubricants, which were used in the engine sump, gear-box, back axle, &c. Nearly all the steel wearing parts exhibited the typical Keenol film. Perhaps the most striking testimony to the quality of the lubricant was provided by the condition of the worm drive to the back axle. When a repair was made to the housing of the back axle assembly, it was put together out of alignment, with the result that the worm had practically to cut a new seating for itself in the worm wheel. In doing so it became overheated. In spite of this occurence the owner was able, after adding a heavier grade of Keenol, to undertake long journeys without a breakdown. It is claimed that no other lubricant than Keenol could have saved this axle from collapse. Other interesting parts were the gear wheels, nearly all of which showed a good film across the working face of each tooth, the cam shaft, of which the working surfaces of the cams had a very easily observable film, and various roller and ball bearings. The following details are also of considerable interest. Carbon deposit taken from the piston top was found to contain 73 per cent. of zinc oxide; grease from the gearbox 0·27 per cent. iron, and oil from the sump 2 per cent. moisture and 0·06 per cent. iron. The small amounts of iron in the lubricants from the engine and gearbox is worthy of remark.

WORLD POWER CONFERENCE.—As already announced, a Sectional meeting of the World Power Conference is to be held in Scandinavia this year. All the Technical Sessions are to take place in Stockholm between Wednesday, June 28th, and July 4th. Forms of application for membership will be available shortly, and may be obtained from the Offices of the Committee, 63, Lincoln's Inn-fields, London, W.C.2. The following British papers have been promised :—(1) "A Survey of Industrial Electric Power Supply in Great Britain," Harold Hobson (Central Electricity Board), F. Forrest (Incorporated Municipal Electrical Association), Charles D. Taite (Incorporated Association of Electric Power Companies); (2) "Long-distance Gas Transmission in England," Dr. E. W. Smith, C.B.E. (Joint Fuel Committee); (3) "The British Coal Survey," Dr. F. S. Sinnatt, M.B.E., and H. E. Mitton (Joint Fuel Committee); (4) "Some Notes on English Electric Practice," A. E. L. Chorlton (Diesel Engine Users Association); (5) "Electric Resistance Furnaces," British National Committee, World Power Conference; (6) "High-frequency Induction Furnaces," British National Committee, World Power Conference; (7) "British Marine Oil Engines," I. V. Robinson, British Marine Oil Engine Manufacturers' Association; (8) "The Handling of Urban and Suburban Passenger Traffic by Railway, Electric Traction, Tramways and Motor Omnibuses," Undergrouud Group of Companies of London.

500-TON COMPRESSION TESTING MACHINE

W. AND T. AVERY, LTD., BIRMINGHAM, ENGINEERS



500-Ton Compression Testing Machine.

THE use of testing machines of large capacity is becoming of increasing importance, owing to the necessity for testing large specimens in investigating the properties of concrete and reinforced concrete and for testing materials in fabricated form. In the testing of concrete, it is also highly desirable that the rate of loading should be controllable. A 500-tons capacity Avery compression testing machine which fulfils these conditions has recently been installed in the Civil Engineering Department of the University of Birmingham. This machine—illustrated herewith—may be used for specimens up to 11ft. in length. Its overall height is 18ft. 6in., but it is sunk 3ft. 9in. below the floor to facilitate the positioning of the heavy and cumbersome specimens.

The straining portion of the machine comprises mainly a cylinder and ram, two columns carried from lugs on the cylinder, and a top crosshead supported upon the columns. The columns are screwed to provide means for the adjustment of the top crosshead. The cylinder is a steel casting with a phosphor bronze liner machined to receive a cast steel ram, 24in. diameter. The ram has a stroke of 9in., and on its top end rests the bottom spherically seated steel platen. This platen is 20in. square, and is faced with a steel plate on which are scribed location lines for the centralisation of specimens. If tests have to be carried out with the bottom platen rigid, a steel ring is inserted under its lip to prevent it from moving on its spherical seat. As the machine is designed primarily to test concrete and similar material liable on fracture to produce dust, &c., which may damage the ram, a suitable guard is fitted beneath the lower platen.

The columns are 8in. diameter, and are screwed to suit the phosphor bronze nuts which rotate on thrust washers housed in the top crosshead. The top crosshead is a steel casting, and carries the top platen which is faced and marked like the lower platen. The top platen has a spherical seating in the top crosshead, and when not in contact with the specimen, is suspended from the top crosshead by four bolts. The crosshead nuts are rotated by worm gearing, the worm shaft of which is driven by a 1½ H.P. constant-speed motor through reduction gearing, to give a crosshead adjustment speed of 4½in. per minute. The motor and gearing are mounted on a bracket at the side of the crosshead, and move with it. Press-button controls for the motor are arranged immediately above the motor starter. To safeguard against damage from overrun of the crosshead, limit switches are arranged at the extreme top and bottom positions. A further limit switch is arranged on the crosshead itself, and is operated when the platen makes full contact with a specimen. When the platen meets the specimen, it is raised in its seating, the upward movement operating the limit switch, which stops the motor.

The hydraulic pressure is provided by a motor-driven oil pumping set. The reciprocating rams are arranged vertically and operate in phosphor bronze liners pressed into the pump body, which is a forged steel block. The rams are of steel, hardened and ground to a fine sliding fit in the sleeves. No packings are used. A cast iron suction bonnet containing the valves is arranged above the rams. The rams are operated from underneath by a main shaft, coupled to a 3 H.P. constant-speed motor running at 750 r.p.m. The full pump delivery permits a maximum speed of ¼in. per minute to the main load ram.

The pressure oil is conveyed to the main load cylinder by way of a control valve on the right-hand side of the cabinet supporting the load indicating dial. The main valve spindle is fitted with a secondary valve, which permits extra fine control. Means are provided in the valve to allow excess oil to be delivered back to the suction tank above the pump motor. A momentum valve between the control valve and the main load cylinder eliminates any pulsations set up by the pump. Further to ensure absence of pulsations at the load indicator, the connection from the main cylinder to the small proportional cylinder—referred to below—is taken direct from the main cylinder. On the left of the cabinet the exhaust valve is fitted. This valve also controls the pressure of oil transmitted from the major cylinder to the small proportional cylinder housed in the dial indicator cabinet.

The load indicator is provided with two reading dials, one at the front and one at the back, and is of the cam resistant type. In the cabinet, on which the indicator is mounted, are arranged a small pressure cylinder and a lever system connected with the dial indicator. The small pressure cylinder is proportionally reduced in area to the main load cylinder. Its ram operates in a phosphor bronze liner, and in order to eliminate friction during a test, this liner is rotated, the drive being obtained from the motor driving the pump. Damping devices are provided to prevent damage to the indicator when a specimen breaks.

The dial has two ranges of graduations, from 0 to 500 tons by ½-ton divisions, and from 0 to 250 tons by ¼-ton divisions. The reading line is 28in. diameter, whilst the scale is shadowless, avoiding parallax errors. A change-lever system permits immediate change from one capacity to another.

An interesting feature is the timing mechanism secured to the glass cover of the front dial. This mechanism has a construction similar to that of a clock, and is provided on its main spindle with a finger which projects inside the glass of the front dial in close proximity to the load-indicating pointer. The clock is equipped with a change gear system, whereby the finger may be made to rotate at various speeds from one revolution in one minute to one revolution in fourteen minutes. Eight fixed-speed changes are provided, and variations between any of the speeds may be obtained by means of a speed regulator. In use, the gears of the clock are set to give the speed corresponding to the rate of loading required. The clock finger is brought opposite to the load indicator pointer by means of a setting knob, and the clock set in motion. The control valve to the main cylinder is then regulated to maintain a loading speed in unison with that fixed by the clock.

When a specimen fractures, the load-indicating pointer returns to its zero position. In order to retain the indication of the load at which the specimen fractures, an electro-mechanical device is fitted to the rear dial. This device consists of an additional finger provided with a friction ring carried in a housing secured to the glass. The housing contains a solenoid which controls a friction pad adjacent to the friction ring on the secondary finger, which is carried round the dial by the load indicating pointer. Whilst that pointer is in contact with the secondary finger, an electrical circuit is completed which energises the solenoid and holds the friction pad free from the ring on the secondary finger, leaving it to rotate freely. When, however, the load pointer recedes, it breaks the solenoid circuit, thus permitting the friction pad to operate and retain the secondary finger at the highest load indication reached.

This machine has been specially designed by W. and T. Avery, Ltd., Soho Foundry, Birmingham, to meet the requirements of Professor C. Batho, D.Sc., M. Inst. C.E., of the University of Birmingham.

MR. H. WYNNE ROBERTS.—We record with regret the death, on February 4th, of Mr. H. V. Wynne Roberts, director and sales manager of the General Electric Company, Ltd., at the early age of forty-nine. Mr. Roberts was born in North Wales on September 12th, 1883, was educated at St. Edmunds School, Canterbury, and joined the General Electric Company in January, 1901, beginning his business career in the counting-house. In November, 1909, he was appointed manager of the engineering supplies and ventilation department; in 1918 he was promoted to the position of sales manager; and in 1929 was appointed a director of the company.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Iron and Steel Industry's Future.

THAT we cannot expect ever again to be the iron and steel-producing country of the world, or to claim to be the steel lords of the world, was the view expressed by the Earl of Dudley, speaking as a Black Country iron and steel master, at the annual dinner of the Staffordshire Iron and Steel Institute on Saturday last. Divergent views were expressed by Sir Gilbert Vyle and the Earl of Dudley. The former, in proposing the toast of "The Iron and Steel Trades," quoted figures of iron and steel production, upon which he congratulated the trades upon their comparatively happy condition when compared with other trades. The figures showed that, almost alone among many trades, they had managed to keep their production up to something near what it was in 1931. The position in the other great iron and steel producing countries of the world was peculiarly bad, compared with the position in England, and the United States had gone to pieces. As far as he could see, the only thing that was wrong about the trades was the prices makers were getting for their products. The main trouble with iron and steel, as with nearly every commodity to-day, was that it was being sold at bankrupt prices, and he could not see that steel-masters were going to look prosperity in the face until they were able to sell their products at something more than those products cost them to produce. The Earl of Dudley, in responding, expressed a very different view. The industry, he said, was still sick, as it had been for ten years. It was suffering from no imaginary illness, but he did not think there was need for despair, though he did not think we should ever see this industry as the staple industry of the country, and it would never again be the staple industry of the district. The Earl of Dudley said Sir Gilbert had quoted statistics to show that, while production had apparently remained steady at home, it had decreased considerably abroad. The answer was that, whereas America, Germany and Belgium had been having a good time during the last few years, the British iron and steel trade had been on its sick-bed since the war. Sir Gilbert had told them that they could not be so ill as they made out, because they were producing the same amount of steel as before the war. Sir Gilbert had forgotten the enormous improvements in furnace practice since the war, which had increased enormously the steel-production possibilities of existing plant. Thus, Sir Gilbert's figures were misleading, and it was really remarkable that steel production should not have been at least twice as much as before the war. He did not think, however, that they need despair, although he did not believe that they could expect to recover their full health. "We cannot expect ever again to be the iron and steel-producing country of the world," he continued. Countries that they had formerly supplied with iron and steel were now determined to manufacture their own as far as possible, and that determination was bound to extend. All we ask for is that our plant as it exists to-day should be fully employed, and we believe it can be fully employed providing we have the first call on our own market and a fair share of the Empire and foreign markets.

Walsall-made Tubes for Warships.

The boiler and superheater tubes in H.M. cruiser "Neptune," the last of the three 7000-ton cruisers of the "Leander" class, launched last week, were made by the Talbot Stead Tube Company, Ltd., of Birchills, Walsall, and similar work is being carried out for the cruiser "Arethusa," now in course of construction. The total value of these orders amounts to about £20,000. Other work on hand includes boiler and superheater tubes for two destroyers, the "Eak" and "Express," which are being built, and the superheater tubes for another two cruisers.

Steel.

The steel trade in this area is as yet feeling no new stimulus, though the reports from other areas and from the shipyards lead to hopes of better times ahead for the Midland branch of the industry. The demand for structural material remains extremely quiet, and rolling stock and other heavy engineering users do not see much substantial ground for hoping to be in a position to absorb much larger tonnages at any rate this quarter. District steel mills are irregularly employed, and the business in hand is unevenly distributed. Selling prices are unaltered, finished material being quoted firmly on the Association level. Angles are £8 7s. 6d., less 15s. rebate to users of native steel only; tees, £9 7s. 6d., less 15s.; joists, £8 15s., less 22s. 6d.; ship, bridge and tank plates, £8 17s. 6d., less 15s. Boiler plates command £8 5s. upwards. There is a rather better demand for steel half-products, alike on home and export account. Makers adhere to recent selling prices. Small steel bars are £6 12s. 6d. upwards for re-rolled and £7 for all-British. Mild steel billets sell at £4 17s. 6d. to £5 7s. 6d., and sheet bars at £4 17s. 6d. upwards. Foreign quotations for semis are too high to attract general attention, and few new orders are being given out. There is still some importation into the district of foreign steel against contracts given out some time ago.

Scrap.

The tone of the steel scrap market is definitely firm. It is believed that an upward movement has definitely commenced and will be strengthened by the increase of activity which has taken place in the Welsh steel works. Recently a fair amount of heavy steel scrap changed hands at £1 10s., Birmingham. Supplies are now being held for a further rise, or released only in very small quantities. Sellers appear to have recovered the initiative, but strong resistance is being offered to the further increase of 2s. 6d. which is being demanded.

Finished Iron.

The Staffordshire finished iron trade continues dull. Most of the works are on short time owing to the scarcity of business, and ironmasters have but small contracts upon their books. Where usually there is a regular call, business is slow and producers have difficulty in finding a market for the whole of their output. As there seems to be no prospect of stimulating demand by price reductions, makers hold to their quotation of £12 per ton. Crown bar makers find competition with competitors from other areas very keen, and values in this branch are decidedly weak. Supplies are obtainable at as low as £8 12s. 6d., but many Staffordshire ironmasters refuse to accept orders at this price, which they consider unremunerative. Common bars sell very slowly, indeed, but makers have received some business of a temporary nature, which, for a long time past, has been placed with Continental firms. Such orders are only for small tonnages, however, to enable manufacturers to carry on pending the development of foreign prices. Manufacturers of wrought iron strip are encouraged by the inquiries they have received in the last week or two, indicating that customers are beginning to show some interest in future requirements. Quotations range from £10 7s. 6d. to £10 10s. per ton delivered.

Galvanised Sheets.

The galvanised sheet trade is making some progress in the export market, though keen competition is encountered from Belgian works. In one or two exceptional cases, it is reported, mills are well occupied with orders for the home market. Inquiries from overseas develop into actual business very slowly. To the export trade the price of 24-gauge corrugateds is £10 10s. f.o.b., and for home business £11 15s. for lots of 10 tons and upwards is charged. The Manufacturers' Association has now extended price control to sales of ridging material. A schedule of prices has been drawn up which represents an advance of about 12½ per cent. on the rates which have ruled of late.

Raw Iron.

Production of Midland brands of pig iron goes quietly along, though furnacemen are compelled to put a proportion of iron into stock. The amount being so disposed of, however, is possibly less weighty than was the case a year ago. Ironfounders are rather cautious in specifying delivery, but makers of light castings, speaking generally, are taking fairly good tonnages. General engineering interests provide very little work at date for the blast-furnaces. Selling values are firmly held. Northamptonshire No. 3 iron is quoted at £3 2s. 6d., and Derbyshire at £3 6s., delivered at stations in the Black Country, and standard basic is also fixed at £3 2s. 6d. delivered South Staffordshire. Forge grades of iron, which command 5s. less per ton in each case, are in poor request, the Staffordshire forges being almost idle. Consumers of pig have not yet quite got down to the anomalies created by the new movement on the part of the Associated Smelters, but in so far as this district is concerned, there has been no interference with business. Users do not, however, relish having to pay more for their iron than is paid by competitors in South Wales. Northamptonshire blast-furnacemen are not now doing so well in Northern markets.

Obituary.

The death took place at Bournemouth on Saturday last of Mr. George F. Chance, who, for many years, was chairman of Chance Bros. and Co., Ltd., Smethwick. Mr. Chance, who was seventy-eight years of age, had been in failing health for a long time, and retired from the chairmanship of the company three years ago, when he was succeeded by his cousin, Mr. Walter L. Chance. He was actively associated with the company for over forty years, and was a well-known figure in the industrial life of Smethwick.

Presentation to a Works Manager.

A dinner was held at the Witton Magnet Club on Wednesday evening, February 1st, and during the proceedings presentations were made to Mr. Heaton in recognition of his services to the General Electric Company, Ltd., as works manager for twenty-one years. The gathering numbered 310 members of the works and shop staff, amongst whom were 130 men who had been associated with Mr. Heaton during the whole of his service, and whose total of service with the company represented over 3000 years. The presentation consisted of a scroll upon which a congratulatory address was engrossed, encased in a silver casket, and was made by Mr. T. G. Woolger (the foreman with the longest record of service), who paid a high tribute to Mr. Heaton, and referred in a graceful speech to the humanitarian way in which he had always performed his managerial duties. A number of other presentations were made, demonstrating the craftsmanship of the various departments throughout the works. During the evening Mr. W. H. Heaton received many messages of congratulation, including one from Sir Hugo Hirst, chairman of the company, and from Mr. Max Railing, director and general manager.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Air Service Extensions.

THERE seems to be a possibility that the municipal aerodrome at Barton, which is controlled by the Manchester Corporation, will become a more active factor in aviation. The undertaking has only been a relatively short time in operation, but latterly its future has been uncertain owing to financial difficulties. During the past week members of the Manchester Corporation Airport Committee have been in personal touch with Mr. Edward Hillman, of Romford, who is associated with several air services in the South of England, and who has been negotiating with the Committee for the lease of the aerodrome with the object of running air services between Manchester and Ireland, and also, it is understood, to and from the Continent. Nothing has been disclosed as to the suggested terms of the lease, and the only statement made so far was to the effect that substantial agreement had been reached on most of the points at issue. At a later stage, there was a danger that the negotiations would come to nought in consequence of what proved to be a misunderstanding, but at the moment of writing the expectation is that the difficulties that have arisen will shortly be overcome, and that further progress will be made with the negotiations. Any agreement that may be reached at this stage must, of course, be provisional in character, for it cannot be made effective without the approval of the Manchester City Council.

The Liverpool-East Lancashire Road.

At a meeting of the Lancashire County Council, Alderman J. Aspell, the Chairman of the Highways and Bridges Committee, said that an appointment had been made for an interview this week with the Ministry of Transport, when it was hoped to obtain sanction to proceed with the asphalt surfacing of the Liverpool–East Lancashire road, which was held up for reasons of economy. Alderman Aspell further stated, with regard to various undertakings in the country which were held up for financial reasons, that he was hopeful that official sanction would shortly be given to continue, at least with roads which were now incomplete.

Non-ferrous Metals.

With the sole exception of spelter, which continues to display slight easiness, all sections of the non-ferrous metals market during the past week have been reasonably steady in tone, with tin, exceptionally, again firmer on balance for the week. In the case of copper, the demand for both standard brands and refined descriptions of the metal continues on a restricted scale, and the immediate outlook is not regarded hopefully. Notwithstanding this, however, quotations for standard copper at the moment of writing are little, if any, different from those that were current a week ago. Buying interest in tin on the English markets has remained on a relatively moderate scale, but some improvement in this respect has been reported from the Continent, and also from the United States. On the strength of this, coupled with a better statistical outlook, values have again moved up, although not to the extent of the rise in the previous week, the gain on balance being between £1 5s. and £1 10s. per ton. There has been a moderate movement in the case of lead, and, in spite of a fairly substantial increase in available home stocks of the metal, current values are much the same as they were at last report. Spelter prices are slightly lower on balance, and only a quiet business has been done.

Iron and Steel.

Conditions on the iron and steel markets here during the past week have been a little better on the whole than they have been so far this year. Foundry iron makers who are selling on the Lancashire markets find that the heavy supplies of good quality machinery scrap, which show no sign of diminution owing to the process of cotton mill dismantling still in progress, a serious handicap to sales, but in spite of this restrictive influence some pig iron producers during the past week have booked rather more new business, including a certain amount of forward buying, although up to the present there has been no perceptible expansion in the aggregate volume of iron going into consumption in the district. Values are generally steady, with Derbyshire, Staffordshire, and Cleveland iron at 67s. per ton, including delivery to users in the Manchester area, Northants at 65s. 6d., Derbyshire forge at 62s., Scottish foundry at about 82s., and West Coast hematite at 80s. 6d. Contract buying in the steel market, except by the few users who have relatively good order books, is almost unknown. There has, however, been a slight expansion in the number of orders for miscellaneous varieties of steel for early delivery, and although the buying has rarely been of important quantities, the aggregate tonnage involved has represented some degree of improvement compared with the experience of late. Steel prices generally have been maintained at recent rates.

BARROW-IN-FURNESS.

Hematite.

There is nothing new to report with regard to the hematite pig iron trade, which continues on the same level that has obtained for the past few weeks. The demand is maintained, and from all the signs does not look like falling off. There are some who anticipate still further advances, but these are not likely to take place in the early future. The Continental and American business has not developed yet, and that will be one of the first signs of a general recovery, in view of the rate of exchange. The local steel departments are still taking a fair proportion of the iron output, and this keeps stocks down. The iron ore trade is quiet in view of the small number of furnaces in blast, and also owing to the small outside demand. Foreign ore is in moderate demand. The steel market continues quiet. There are not many orders available, but this district is getting its share. Fuel continues to be in quiet demand.

Shipbuilding and Machinery.

Much is being said in the daily Press of the Admiralty orders which are likely to be placed within the next month or so, but it would be as well if rumours are taken with some caution. It is known that Barrow will get its share, as is only to be expected, but it is too early to give any idea of the actual orders.

SHEFFIELD.

(From our own Correspondent.)

The Heavy Trades.

THE heavy trades of Sheffield and district are still short of work, and production is on a scale much below capacity. At the same time, somewhat improved activity is reported in one or two directions, and it is believed that progress towards a revival is being made. It is reported that the Firth-Brown firm has two Siemens furnaces in commission, as compared with one a month ago. The United Steel Companies are more active in the Rotherham melting department, where special steels are made, and the Park Gate Company is doing better in the steel pit-arch section. In other respects, employment at these firms remains at about recent levels. A fair volume of work is on hand at the establishments of the English Steel Corporation and Industrial Steels, Ltd. Railway and shipbuilding work is still very scarce, but there are grounds for hope of improvement in both these directions. Conditions at the rolling mills are mixed, and for the most part unsatisfactory, but the electric furnaces are able to give a rather better account of themselves.

In North Lincolnshire.

The state of things in North Lincolnshire, although not good, is a little better than it was. There are now two blast-furnaces operating at the Frodingham works—one which was shut down before Christmas for repairs having just been restarted—two at the Appleby works, and three at the Normanby Park Steel Works, making a total of seven working in the Scunthorpe district out of nineteen. Better reports come to hand with regard to the mill departments at John Lysaght's.

Shipbuilding and Railway Steel.

The building of ships brings work to Sheffield in a great variety of directions, and the improvement in the placing of orders for new mercantile tonnage, and the speeding-up of work by the Admiralty, encourage Sheffield to hope for better times. Lord Stanley, Parliamentary Secretary to the Admiralty, informed a deputation from the Engineering and Shipbuilding Federation last week that the Admiralty was to build up to the maximum allowance allotted to Great Britain under the Washington Treaty. He discussed the programmes of the last three years. With respect to the 1932 programme, he said that three cruisers which would have been placed about the end of March or later had been brought forward, and orders for their construction would be given within the next few days. As to the programme for destroyers and sloops, which would not normally have been ordered before May, it had been decided to place all these vessels under contract now, so that as much work as possible would be given to the shipyards. Lord Stanley also intimated that twenty-three other types of vessels under Admiralty contract would be placed in February. *Quality*, the organ of the Sheffield Chamber of Commerce, contains an article calling attention to the impending placing of British naval work, and also stating that contracts have been booked by British shipbuilders on Portuguese and Brazilian accounts; and remarks that all this spells work for Sheffield firms' making plates, bars, guns, armour, engine parts, tools, fittings, and so on. The article also refers to railway work. "Vast railway extension schemes," it says, "mapped out before the war in South America, India, and in Africa, and held up, first by the war, next by the high price of steel after the war, and still later by political and financial difficulties, may soon be taken in hand and pushed forward, and the demand for rails, engines, coaches, wagons, and other railway equipments will then be greater than at any time since the middle of the nineteenth century."

The Lighter Trades.

There is a good deal of work on hand in the branches catering for the motor car makers, though it is not up to recent averages. The demand for stainless, non-corrodible, and heat-resisting steels is fairly well maintained, and tool makers on the whole are fairly busy, with good employment in some sections. The makers of permanent magnets are still turning out large quantities of goods, but there has been a great falling off since the boom just before Christmas, and, compared with that period, conditions may be described as slack. There are good inquiries from Canada with regard to tools, steel, and cutlery to replace goods hitherto obtained from foreign sources, and also with regard to agencies for British commodities. Export trade generally tends to expand, works, both abroad and at home, which had allowed their stocks to run very low, showing a disposition to replenish them.

Competitive Prices.

Sheffield is in an excellent position to secure a much greater share of orders, when international trade returns to normality, than it obtained before the slump in trade. The production of many local commodities is now both more efficient and more economical than ever before, and a record low level of prices has been reached. Even if foreign goods were available, they would be little, if anything, cheaper than the products of Sheffield.

Up to Pre-war Output.

The striking statement that, in spite of depression in the heavy trades, and idle productive capacity, Sheffield is still producing as much in total volume—and even more in value and variety—than the ordinary pre-war output, is made in the article in *Quality*, to which I have already referred. "In the midst of general trade depression," it says, "with the world's consumption of steel not only less than one-half that of 1929, but one-third less than in the last pre-war year, 1913, Sheffield is making and converting into finished goods a quantity of steel at least equal to the average tonnage of the last five pre-war years."

Empire Content.

The lighter trades of Sheffield are interested in the new "Empire content" regulation, but it does not go far enough to satisfy them. The regulation, which has been made under the Import Duties Act, 1932, prescribes that certain classes of goods manufactured in and consigned from a part of the Empire must contain a minimum of 50 per cent. of Empire material and labour in order to qualify for Imperial preference, instead of 25 per cent. as at present. While this increased percentage is regarded in Sheffield as a valuable move in the right direction, it is urged that something still higher is required, to give proper protection to Sheffield saws, files, twist drills, and other light manufactures. A proportion up to 75 per cent. is contended for, and representations to this effect have been made to the Board of Trade. Readers will recall the remarks of Mr. T. Nightingale on this subject, which I quoted in my letter of January 10th.

Trade Marks Inquiry.

Sheffield is specially interested in the question of trade marks, as it possesses, in the Cutlers' Company, a body which has the important function of registering local trade marks for goods composed wholly or partly of metal. The city will therefore follow carefully the proceedings of the new Committee which has been appointed by the President of the Board of Trade to report whether any, and if so what, changes in the existing law and practice relating to trade marks are desirable. The Master Cutler (Lieut.-Colonel A. N. Lee) is a member of the Committee.

Cutlery and Plate.

The position of the cutlery and plate trade, so far as general lines are concerned, is still very unsatisfactory. There is little demand for quality goods, and few of the factories are operating on a remunerative basis. The safety razor and blade branch, however, continues very busy, and there is also good employment in the scissors trade. Although Sheffield is now in a position to compete for much of the cheap trade formerly done by Germany, it remains to be seen whether it will jump at a chance which has just been reported. It used to be thought that a stainless table knife which sold retail at 6d. was the last word in cheap cutlery. The Chamber of Commerce has, however, received a communication from Montreal asking for makers of cutlery who are prepared to quote for cheap stainless knives to be given away as premiums—knives which "should compete favourably in price as well as quality with German goods, and should cost in the neighbourhood of 18s. a gross!" The 1¼d. stainless knife is not likely, one would think, to be an attractive proposition to Sheffield.

NORTH OF ENGLAND.

(From our own Correspondent.)

Shipbuilding Revival.

THE improvement in the shipbuilding industry is likely to be continued by the booking of further contracts in which the North-East Coast yards will share. At the same time a boom in the industry is not to be expected, and the shipyards are so empty of work that it will take a very large number of orders before anything like a normal position can be regained. The Tyne in November reached the unenviable position of not having a vessel left on the stocks. There was some naval work to be begun, and since then further contracts have been booked which will result in much greater activity at Wallsend, Hebburn, and South Shields than for some time past. These contracts include six naval vessels, an oil carrier, and two cargo vessels. It is probable that this amount of work will be augmented, and it is almost certain to be in regard to the new naval work which may be announced at any time. It is anticipated that the Tyne will get at least a cruiser and some destroyers. At Jarrow the allocation of the work is keenly awaited as Palmers Company has dispatched its last ship, and as the town practically depends on this firm, with its fine record of naval and other work over a period of eighty years, there are now 80 per cent. of the workmen unemployed and the depression is being keenly felt. It will be a great disappointment if Jarrow, which did not receive any share of the last programme given out, is again unfortunate on this occasion. The Furness Shipbuilding Company, Haverton Hill-on-Tees, has secured orders this week for three vessels, two of 9000 tons deadweight carrying capacity for British owners, and one of 7000 tons, to be built to the order and design of Sir Joseph Isherwood. The two bigger vessels will have Diesel engines, and are intended for fast cargo service. These orders will give at least nine months' work to the yard, and will lead to the re-engagement of hundreds of men who were paid off many months ago. Another vessel of 7000 tons is to be built on the Isherwood principle by Messrs. Shorts, of Sunderland. As all-British steel is to be used in the construction of the vessels, the local steel industry should also benfit considerably.

Big Contract for Tyneside.

An important contract for the construction of a complete Diesel-electric express train—including everything from power unit and coaches to luggage racks and ash trays—has been placed with Sir W. G. Armstrong, Whitworth and Co., Ltd., Scotswood, Newcastle. The train has been ordered by the San Paulo Railway of Brazil, and is believed to be the first complete train ever to be built by one firm. It is to run on express services between San Paulo, the capital of the State, and the Harbour of Santos.

Cleveland Iron Trade.

There is no marked change to record in the Cleveland pig iron trade this week. Business has been somewhat quiet since the new scale of prices was introduced, but the position has now been regularised, and as the consuming trades are becoming more active, better business is looked for. Although there have been no important market movements, the volume of inquiry is growing, and is of a hopeful character. For delivery to consumers in the Teesside area, No. 1 Cleveland foundry iron is 65s., No. 3 G.M.B. 62s. 6d., and No. 4 forge 61s. 6d. To customers within 50 miles west of Middlesbrough and extending from the Midlands to the Scottish border, delivery prices are 2s. above the foregoing figures, and buyers beyond that area are charged up to 6s. 6d. above rates named for local consumption. Delivery prices to the Glasgow area are based on No. 3 G.M.B. at 62s. 6d.

Hematite Pig Iron.

The East Coast hematite pig iron trade has developed greater activity, buyers evidently deeming it wise to acquire supplies before the market moves against them. Some substantial sales have been made to South Wales, but 59s. can still be shaded for mixed numbers and 59s. 6d. for No. 1 quality.

Ironmaking Materials.

Business in foreign ore is virtually at a standstill. Small prompt purchases are possible at the equivalent of best Rubio ore at 15s. 3d. c.i.f. Tees, but sellers will not entertain offers for delivery over periods ahead except on much higher terms. Blast-furnace coke is in ample supply and in only moderate request. There are sellers on the basis of good medium qualities at 16s. delivered at the works.

Manufactured Iron and Steel.

Finished iron and steel quotations are steadily upheld. Producers of steel semis have a good deal of work to execute as a result of protection in the home market. Producers of ship plates, angles and rivets expect soon to be busier than for some time, and further orders for railway material are likely to be obtained, while some improvement in demand for sheets is reported. Manufacturers of structural steel, however, are much in need of new contracts.

Exports and Imports.

The outstanding feature of the pig iron shipments from the Tees during the past month was the improved deliveries to home ports, and it would appear that the ironmasters are at last beginning to feel the benefit of a protected home market. The coastwise shipments last month totalled 6971 tons, which compares with 5315 tons in December, and, with one exception, is the highest monthly figure since June of last year. The foreign shipments of pig iron fell from 4618 tons in December to 2279 tons in January, of which latter total 1100 tons went to Denmark. The manufactured iron and steel shipments for January totalled 23,083 tons, as compared with 25,589 tons in December. The coastwise deliveries advanced from 9974 tons to 11,751 tons in January, but in the same period the clearances to foreign ports declined from 15,615 tons to 11,332 tons. The principal foreign customers were India, with 1984 tons, South Africa 1701 tons, and Argentine 1481 tons. The remarkable effect of the tariff duties is reflected in the import statistics. These show that in November, December, and January the imports of foreign ore and steel into the Tees totalled only 1957 tons, as compared with 50,274 tons in the corresponding period of a year ago, and 17,119 tons in the corresponding three months of 1913–14. In January, 1092 tons were imported, as against 16,726 tons a year ago.

The Coal Trade.

The recent keen pressure for supplies in the Northern coal trade is steadily easing off. Contractors especially are showing anxiety as to the clearance of their commitments for the remainder of the month. The mild weather has rapidly eased the home demand for supplies, allowing more to be offered for export. There do not, however, appear to be any large foreign inquiries on the market at present. The general outlook, in fact, is uncertain. Some merchants incline to the belief that another quiet spell is about to characterise the export trade. They point to the severe import restrictions abroad, in the first place, and the difficulty there is of doing business on the basis of minimum prices. It would be harmful to exaggerate the position as to prices at which coal is sold abroad, but it is often asserted that evasions of the marketing schemes take place. Northumberland steam coal collieries are fairly well booked to the end of next week, and any surplus is held steadily at recent prices, but for the second half of the month overseas buyers are marking time. Sellers are, consequently, numerous and pressing on the market, and buyers able to stem suitable tonnage to fit available loading turns can obtain substantial discounts. Best Northumberland steams are quoted at 13s. 9d. to 14s. 3d., Tyne primes 13s. 3d. to 13s. 6d., and other descriptions 12s. 6d. Durham prime steams are firmer for prompt at 16s., and steady forward at 15s. 6d. to 16s. There is a good general demand for best class bunkers, and output is readily cleared at 14s. 6d. to 14s. 9d. Secondary bunker qualities, however, are again becoming plentiful and quoted easy at 13s. to 13s. 6d. Durham gas coals are moving steadily at 14s. 6d., and special Wear qualities at 15s. Secondary gas is plentiful at 13s. to 13s. 6d. No special movement is reported in the coke trade. There is substantial pressure for gas coke, but supply is scarce, and buyers have to seek elsewhere to cover their requirements. Best qualities are quoted at 18s. 6d. and vertical at 22s. 6d. Patent oven coke is steady at 15s. Démand for coke nuts is not so brisk, but prices remain steady at 16s. 6d. to 17s. 6d.

SCOTLAND.

(From our own Correspondent.)

Shipbuilding.

ALTHOUGH there is yet a long way to travel before the activity in the shipbuilding industry approaches normal, the recent improvement is maintained and prospects are considerably brighter. Orders booked for the Clyde during last month totalled more than during the first eight months last year. Only two vessels were launched on the Clyde last month, one of which was the destroyer

"Vouga," built by Messrs. Yarrow and Co. for the Portuguese Government. Orders booked since the end of last year include a passenger and cargo steamer for London owners, a cargo steamer of 4000 tons for Glasgow owners, a cargo steamer of 2000 tons for Liverpool owners, and a gunboat for the British Admiralty. The Burntisland Shipbuilding Company received an order for two cargo boats of 8500 tons deadweight each, for the Moor Line, Ltd. The Burntisland Company has at present orders for seven cargo boats. A further report states that Clyde firms will secure on behalf of the Admiralty orders for a cruiser, another large vessel, four destroyers, and several small craft, including a submarine, also an order for machinery. The official announcement will be made within a few weeks. Inquiries for cargo vessels still come to hand, and there are good prospects of orders for that class of boat.

Steel.

Scottish steel makers still await a revival in the main consuming industries so far as heavy steel is concerned, and meantime plants are working on a hand-to-mouth basis. Tube makers are not particularly well off for orders at present, but with inquiries maintained are hopeful that the export tonnage will show an improvement over last year's output, which was larger than in 1931. Specifications for sheets of the heavier gauges are still scarce, but the demand for the lighter varieties is fully maintained. There is an increasing demand for special qualities. A fair proportion of the present output is absorbed by the home market, but some good orders have been booked for the Far East.

Iron.

There is no improvement in the demand for bar iron. Re-rolled steel bars are in a similar position. The home demand is small and export is difficult in face of foreign competition. Belgian bars are quoted £2 7s. 6d. per ton (gold) f.o.b. Antwerp, and though subject to a tariff of 33⅓ per cent., can be delivered here under local prices, which are still quoted £7 5s. home and £6 10s. per ton export.

Pig Iron.

The Scottish pig iron market is still very dull and the output from the two furnaces in operation is more than sufficient to meet all requirements. During the week 500 tons of pig iron arrived in this district from Millom. Prices are unchanged.

Scrap.

There has been a little more movement in scrap, and prices are steady at 37s. 6d. for heavy steel and 47s. 6d. per ton cast iron machinery.

Coal.

No change of importance has taken place in the Scottish coal trade during the past week. West of Scotland collieries are disposing of their outputs chiefly in the home market. In the Lothians and Fifeshire, shipments are mainly against old contracts, new export business being scarce. Screened fuels are firmly held, however, and some sorts, especially Cowdenbeath-Lochgelly, are almost unobtainable for delivery this month. All sizes of nuts are again a shade firmer. Aggregate shipments amounted to 242,881 tons, against 232,666 tons in the preceding week and 215,415 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

The Coal Trade.

NOTWITHSTANDING the adverse conditions prevailing, shipments of coal and coke from the six leading ports in this area last week showed a slight improvement. At one time, owing to the bad weather preventing the arrival of tonnage, there were as many as forty idle tipping appliances at the various docks, yet the returns show that shipments reached a total of 375,935 tons, which compared with 354,215 tons for the preceding week and with 363,458 tons for the corresponding period of last year. All things considered, the present week started by no means unfavourably, as on Monday the number of idle tipping appliances was reduced to twenty-one, while at Swansea all berths were occupied and one steamer was waiting. Still, the conditions in the steam coal trade continue to be quiet and featureless, and new business for early loading provides very little of interest, yet it is evident that business is being done, as otherwise shipments would not be as good as they are. The fact is that less and less business nowadays comes on the open market, but it is done through the big combines. As regards contract operations, the most important item of news is that preliminary notice has been received that the Egyptian State Railways are now calling for tenders for 220,000 metric tons of locomotive coal. Prices have to be in on March 21st next, and it is understood that firms are being asked to quote for 60,000 metric tons on an f.o.b. basis and 160,000 metric tons on a c.i.f. basis Alexandria. The coals are to be delivered from May to September, so that the period rather overlaps the contract which these railways entered into at the beginning of this year with T. Beynon and Co., Ltd., of Cardiff, viz., for 66,000 metric tons at 24s. 3d. per ton c.i.f. Alexandria, for delivery between April and June. Other contract business concerns inland undertakings. The Swansea Corporation electricity department has called for tenders by May 1st for six or twelve months' supplies of sized coals for the mechanical stoking appliances at their electricity station, and the Metropolitan Board of Works are in the market for 34,000 tons of sized coals for delivery over six months.

Twenty-Ton Wagons.

The letter which was issued recently by the G.W.R. Company relative to its scheme for the construction of five thousand 20-ton wagons, costing about £1,000,000, came up for consideration last week by the Commercial Committee of the South Wales Coalowners, and it was then decided that the secretary should communicate with the general manager of the company, Sir James Milne, in order to clear up certain points in connection with the matter. One of these points on which coalowners as a body naturally require some assurance relates to the question of the continuance of the existing rebate granted to users of 20-ton wagons, while, furthermore, it is thought that additional information should be forthcoming regarding the provision of adequate facilities for handling these larger wagons at the docks in the event of their coming into use. Since then it is understood that the Great Western Railway Company is satisfied with the response so far accorded to its scheme, and has sent out tender forms for the construction of the proposed five thousand 20-ton wagons, replies to be in early next week.

Coalfield Items.

The report was current some time ago that the French Government contemplated abolishing the import quota scheme, but this is now officially denied, and it is understood that the import quota for coals for the current month is fixed at 65 per cent. of the datum period, this being 5 per cent. reduction. It consists of 53 per cent. to importers and of 12 per cent. at the disposal of the Director of Mines. The additional 100,000 tons for seaborne imports is to be continued as for the past few months. Almost every day reports are to hand of cases of stealing coal, and in this connection it is of interest to note that in appealing to the Newport county magistrates on Saturday that they should take a serious view of such cases, it was stated by Mr. J. K. Wood that the Monmouthshire and South Wales Coalowners' Association had complained that 1 per cent. of the coal mined in South Wales last year had been stolen, causing a loss of £250,000. The Great Western Railway Company had prosecuted in 490 cases last year, and special arrangements had been made to protect coal trains, at a cost of £20 per week, in one area alone. New pithead baths were opened on Saturday last at the Navigation Colliery, Crumlin, belonging to Partridge, Jones and Paton, Ltd. They provide accommodation for about 800 men, and their estimated cost is £18,000. Similar baths were opened on Tuesday at the Deep Duffryn (Llewellyn-Nixon) Colliery, Mountain Ash, constructed at an approximate cost of £14,000. These baths will accommodate about 900 men, and are the first to be erected in the Aberdare Valley.

Steel and Tin-plate Trade.

The men's side of the Welsh Tin-plate Joint Industrial Council met at Swansea at the end of last week, when reports were received regarding the progress of the scheme for the application of six-hour shifts in the industry for the purpose of absorbing unemployed. It was reported that the scheme had not been adopted at Llanelly or Gorseinon, but the members present at the meeting passed a resolution expressing their intention to pursue the matter. It was also reported that the employers had extended the notice terminating the sliding scale for another three months, and had agreed to continue the payment of the *ex-gratia* bonus of 7½ per cent. to the lower-paid men.

The Shipping Industry.

As the result of the severe depression in the shipping industry, close on sixty Cardiff steamers were disposed of last year, and several have since changed hands this year. It is, in fact, two years or more since a Cardiff firm placed an order for new tonnage. This being so, it is somewhat refreshing to note that there is some foundation for the report that one leading local undertaking contemplates placing an order for the supply of two new cargo vessels suitable for the American trades. Negotiations are proceeding between the firm in question and North-East Coast shipbuilders, but it will come somewhat as a shock to those interested in the Back-to-Coal movement when they hear that it is contemplated that the new vessels shall be oil burners, because of the cheapness of oil at American ports. It is understood that the new service, which commenced at the beginning of this year between Canadian ports and Cardiff and Bristol, is proving a definite success. This service is being worked by Messrs. Charles Hill and Sons, of Bristol, two of the vessels which have already discharged large quantities of general goods being the s.s. "Boston City" and "Bristol City." A third, the s.s. "New York City," is due to arrive at the end of this month. At the moment the only port of call on the other side is Halifax, but when navigation opens, vessels will take cargo at Montreal, Quebec, and other St. Lawrence ports.

Current Business.

New business for prompt loading rules quiet, but whereas most descriptions of large coal are plentiful and obtainable at the minima, sized and washed coals are very scarce and remain firm at a premium. Coke moves off fairly well, and patent fuel is comfortably stemmed, but pitwood is a weak market at 19s. 6d. to 20s., the colliery demand being very slow and irregular.

EDUCATIONAL INTELLIGENCE.

UNIVERSITY OF LONDON, KING'S COLLEGE, STRAND, W.C.2.—In the Department of Electrical Engineering. A Course of three Lectures will be given on Tuesdays, at 5.30 p.m., on "The Theory of the Induction Motor," by F. T. Chapman, D.Sc. (Eng.) Lond., M.I.E.E., A.M. Inst. C.E. The lectures will be illustrated by oscillographic demonstrations and by cinematograph films. Admission free without ticket.

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY.—Sir William Larke's lecture on the "Steel Industry" will be given in the Huxley Building of the Royal College of Science at 4 p.m. on Thursday, February 23rd, 1933, instead of on the 16th of that month, as originally arranged.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

BENES, Ltd., informs us that its general offices have been transferred to the registered office at 324, Gray's Inn-road London, W.C.1 (phone No., Terminus 6275).

THE "R.N." Diesel Engine Company has moved into "Britannia" House, Ampton-street, London, W.C.1 (telephone, Terminus 6361, 6362, 6363; telegrams, "Brimotobo Kincross London").

MR. HORACE J. YOUNG, who was appointed to take charge of the foundry and research departments of Hepworth and Grandage, Ltd., St. John's Works, Bradford, has now been appointed a director of the company.

KNIGHT, FRANK AND RUTLEY announce that they have taken into partnership three members of their staff who have been with them for many years, namely, Mr. Gordon M. Cannon, Mr. Herbert D. Kelleway, and Mr. Charles J. Woosnam.

MR. ARTHUR IMBERY, A.M.I.E.E., late managing director of British Resistor Company, Ltd., Trafford Park, Manchester, has commenced business on his own account as consulting engineer. Correspondence to St. Albans-avenue, Halifax.

EDWARD G. HERBERT, Ltd., of Atlas Works, Levenshulme, Manchester, announces that representation in Yorkshire has been taken over by Mr. Alan Keirnan, A.M.I. Mech. E., working from head office, in place of Mr. Bernard D. Eagin, of Leeds.

JOHN PICKLES AND SON (ENGINEERS), Ltd., Hebden Bridge, England, have purchased the business and goodwill, together with patterns, drawings, &c., of A. Ransome and Co., Ltd., of Stanley Works, Newark-on-Trent, a firm which came into existence in 1855.

CONTRACTS.

MELDRUMS, Ltd., Timperley, near Manchester, has received a repeat order for a destructor plant to be installed at Jerusalem.

BELLISS AND MORCOM, Ltd., Birmingham, have received from the Champion Reef Gold Mines of India, Ltd., through their consulting engineers, Messrs. Rooper and Chalmers, London, an order for a 10,000 cubic foot motor-driven turbo-compressor.

THE GENERAL ELECTRIC COMPANY, Ltd., has secured a contract to supply the Admiralty with 12,350 carbon lamps of the gunsight and tubular type and 19,500 Osram metal filament lamps.

ENGINEERS' GERMAN CIRCLE.—The first of the second series of lectures arranged by the Engineers' German Circle took place on Monday evening last, February 6th, at the Institution of Mechanical Engineers, and there was an attendance of over eighty members and guests. A paper reviewing the development of iron and steel manufacture from the sixteenth century smelting furnace to the modern blast-furnace and steel plant was presented by Mr. Victor B. Reichwald, of London, and was illustrated by a large collection of lantern slides. Several of the slides were of historical interest, depicting methods of manufacture which have now been superseded. In the course of his paper Mr. Reichwald referred to figures for the world production of pig iron, which during 1932 only totalled thirty-eight million tons, as against seventy-eight million tons in 1930, and about the same output in 1913. In a brief speech Herr E. H. Ruoter, of the German Embassy, congratulated the Circle on reaching its first birthday and on the progress it was making. After the paper an informal dinner was held at the Anglo-German Club, Carlton Gardens. The next meeting is to be held on Monday, February 20th, when Herr Dip.-Ing. Ernst Kugel, of the Schloemann A.G., Düsseldorf, will deal with new developments in the design of rolling mill equipment.

INSTITUTION OF CIVIL ENGINEERS.—The twelfth annual dinner of the Manchester and District Association of the Institution of Civil Engineers was held at the Midland Hotel, Manchester, on Wednesday, February 1st, and was well attended. Sir Murdoch MacDonald, President of the Institution, was unable to be present, and his duties were undertaken by Mr. H. A. Reed, member of Council. The toast of "The Manchester and District Association" was proposed by Mr. J. Hubert Worthington, F.R.I.B.A., President of the Manchester Society of Architects. He said that engineers and architects were now getting closer together. The rising generation of architects loathed columns hung on buildings and fussy ornamentation. It was absorbed with functionalism, and thought in terms of engineering. Mr. Worthington spoke with admiration of the modern underground stations in London and referred to the new Battersea power station as showing a happy co-operation between the late Mr. T. Halliday, Messrs. C. Allott and Sons—the civil engineers—and Sir Giles Gilbert Scott. Mr. P. W. Bertlin, M. Inst. C.E., Chairman of the Manchester and District Association, acknowledged the toast. The toast of "The Cities of Manchester and Salford" was proposed by Mr. T. D. Barlow, President of the Manchester Chamber of Commerce. He deprecated the southern trend of industry when developed areas like Manchester already existed. He said that in the past Lancashire had thought too much in terms of big industries, and that it was necessary to change its views. With that object the district should endeavour to develop smaller industries with factories employing from thirty to forty hands, as was frequent in the Birmingham district.

DIESEL ENGINE USERS ASSOCIATION.—The annual dinner of the Diesel Engine Users Association was held on Tuesday evening, February 7th, at the Coventry Restaurant. The President, Mr. C. F. Mounsdon, took the chair, and a large number of members and guests, principally representing oil engine users, and allied interests, were present. The toast of "The Association" was proposed by Mr. J. Kewley, President of the Institution of Petroleum Technologists, who referred to the wide range of fuels now available for the oil engine. He advocated closer co-operation between the manufacturer, the users, and the oil companies, with a view to obtaining the best types of fuel, and referred, in this connection, to the World Oil Congress, which is to be held in London in July, at which, he said, such matters could conveniently be discussed. In his reply, the President said that there were now 250 members of the Diesel Engine Users Association, and 308 subscribers, who, together, represented between 800,000 and 1,000,000 horse-power of oil engines. Speaking of the grid scheme, Mr. Mounsdon said that when new plant had to be considered, the case of the oil-engine-driven generator plant at £10 per kW complete, with a generating cost of less than a farthing per unit, could not be overlooked. British builders were now prepared, he said, to offer large-powered units. In the absence of Mr. A. Cornwall-Walker, Mr. W. A. Tookey proposed the toast of "Our Guests," and Dr. W. R. Ormandy, Mr. W. A. S. Calder, and Mr. Alan Chorlton responded. The toast of "The Technical Press" was proposed in an appreciative manner by Mr. J. G. Griffin. Mr. W. Roylands Cooper and Mr. A. P. Chalkley briefly replied, and referred to the excellent work the Association is carrying on. Mr. F. A. Greene proposed the health of the President, and thanked Eng.-Rear-Admiral J. Hope Harrison for the pleasing arrangements he had made.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
(1) Native	15/- to 20/-
(1) Spanish	17/- to 24/-
N.E. COAST—	
Native	18/- to 21/-
Foreign (c.i.f.)	15/3

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(3) SCOTLAND—		
Hematite	3 6 0	—
No. 1 Foundry	3 10 0	—
No. 3 Foundry	3 7 6	—
N.E. COAST—		
Hematite Mixed Nos.	2 19 0	2 19 0
No. 1	2 19 6	2 19 6
(f) Cleveland—		
No. 1	3 5 0	3 1 0
Siliceous Iron	3 5 0	3 1 0
No. 3 G.M.B.	3 2 6	2 18 6
No. 4 Foundry	3 1 6	2 17 6
No. 4 Forge	3 1 0	2 17 0
Mottled	3 0 6	2 16 6
White	3 0 6	2 16 6
MIDLANDS—		
(e) Staffs.—	(*Delivered to Station.*)	
All-mine (Cold-blast)	—	—
North Staffs. Forge	3 1 0	—
„ „ Foundry	3 6 0	—
(e) Northampton—		
Foundry No. 3	3 2 6	—
Forge	2 17 6	—
(e) Derbyshire—		
No. 3 Foundry	3 6 0	—
Forge	3 1 0	—
(3) Lincolnshire—		
No. 3 Foundry	—	—
No. 4 Forge	—	—
Basic	—	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	3 15 6 (*a*); 4 0 6 (*b*); 4 5 6 (*c*)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	9 15 0	9 5 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 5 0	—
Common Bars	9 5 0	—
Best Bars	10 5 0	—
Double Best Bars	10 15 0	—
Treble Best Bars	11 5 0	—
LANCS.—		
Crown Bars	9 15 0	—
Best Bars	10 5 0	—
Hoops	12 0 0	—
S. YORKS.—		
Crown Bars	9 15 0	—
Best Bars	10 15 0	—
Hoops	12 0 0	—
MIDLANDS—		
Crown Bars	8 12 6 to 9 5 0	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	8 0 0 to 8 10 0	—
Gas Tube Strip	10 7 6 to 10 10 0	—

STEEL. (d)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates (Marine)	9 0 0	8 10 0
„ „ (Land)	—	—
Ship Plates, ½in. and up	8 15 0	7 15 0
Sections	8 7 6	7 7 6
Steel Sheets, ¼in.	7 15 0	7 15 0
Sheets (Gal. Cor. 24 B.G.)	11 5 0–10 Ton Lots and Upwards Delivered Glasgow Stations.	10 0 0
„ (Gal. Cor. 24 B.G.)	For Canada separately arranged	

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 15 0	7 15 0
Angles	8 7 6	7 7 6
Boiler Plates (Marine)	10 10 0	—
„ „ (Land)	10 0 0	—
Joists	8 15 0	7 7 6
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	7 2 6	—
Soft Billets	5 10 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	—
Billets	6 10 0 to 9 0 0	—
MANCHESTER—		
Bars (Round)	9 7 6	—
„ (Small Round)	6 15 0	—
Hoops (Baling)	10 0 0	9 15 0
„ (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
„ (Lancs. Boiler)	8 10 0	—
SHEFFIELD—		
Siemens Acid Billets	9 2 6 (basis)	—
Hard Basic	8 2 6 and 8 12 6	—
Intermediate Basic	6 12 6 and 7 2 6	—
Soft Basic	5 15 0	—
Hoops	9 10 0 to 9 15 0	—
Soft Wire Rods	7 10 0	—
MIDLANDS—		
Small Rolled Bars (all British)	7 0 0 to 7 5 0	—
Small Re-rolled Bars	6 12 6 to 6 17 6	—
Billets and Sheet Bars	4 17 6 to 5 7 6	—
Galv. Sheets	11 15 0 to 13 15 0	10 10 0
(2) Staffordshire Hoops	9 10 0	—
(d) Angles	8 7 6	—
(d) Joists	8 15 0	—
(d) Tees	9 7 6	—
(d) Bridge and Tank Plates	8 17 6	—
Boiler Plates	8 5 0 to 8 7 6	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14 f.o.b.	15/9 to 16/-
Block Tin (cash)	149 12 6
„ (three months)	150 0 0
Copper (cash)	28 8 9
„ (three months)	28 13 9
Spanish Lead (cash)	10 7 6
„ „ (three months)	10 15 0
Spelter (cash)	13 15 0
„ (three months)	14 1 3
MANCHESTER—	
Copper, Best Selected Ingots	32 10 0
„ Electrolytic	33 10 0
„ Strong Sheets	65 0 0
„ Tubes (Basis Price), lb.	0 0 10
Brass Tubes (Basis Price), lb.	0 0 9
„ Condenser, lb.	0 0 11¼
Lead, English	12 7 6
„ Foreign	11 2 6
Spelter	14 2 6
Aluminium (per ton—raw ingot)	£95

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/10½ per lb.	
Ferro Tungsten	1/7½ per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£25 15 0	8/-
„ „ 6 p.c. to 8 p.c.	£24 10 0	7/6
„ „ 8 p.c. to 10 p.c.	£22 5 0	7/-
„ „ Specially Refined		
„ „ Max. 2 p.c. carbon	£36 10 0	11/-
„ „ „ 1 p.c. carbon	£42 12 0	14/-
„ „ „ 0·70 p.c. carbon	£44 0 0	16/-
„ „ „ carbon free	1/- per lb.	
Metallic Chromium	2/9 per lb.	
Ferro Manganese (per ton)	£10 15 0 for home	
„ „ „	£9 15 0 for export	
„ Silicon, 45 p.c. to 50 p.c.	£13 10 0 scale 5/- per unit	
„ „ 75 p.c.	£19 10 0 scale 6/- per unit	
„ Vanadium	12/6 per lb.	
„ Molybdenum	6/3 per lb.	
„ Titanium (carbon free)	9d. per lb.	
Nickel (per ton)	£245 0 0	
Ferro Cobalt	7/9 per lb.	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	15/6
„ „ Ell	16/- to 16/6
„ „ Splint	16/- to 17/6
„ „ Trebles	15/-
„ „ Doubles	12/-
„ „ Singles	10/6 to 10/9
AYRSHIRE—	
(f.o.b. Ports)—Steam	14/-
„ „ Jewel	16/6
„ „ Trebles	15/6
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	13/- to 15/-
Screened Navigation	16/6 to 17/6
Trebles	15/6 to 16/-
Doubles	12/6 to 13/6
Singles	10/6 to 10/9
LOTHIANS—	
(f.o.b. Leith)—Best Steam	14/-
Secondary Steam	13/6
Trebles	15/6
Doubles	11/9
Singles	10/6

(8) N.W. COAST— ENGLAND.

Steams	19/- to 23/6
Household	32/6 to 52/6
Coke	18/- to 21/6
NORTHUMBERLAND—	
Best Steams	14/6
Second Steams	12/6 to 12/9
Steam Smalls	8/6
Unscreened	12/6 to 13/-
Household	27/- to 39/-
DURHAM—	
Best Gas	14/6
Second	13/3 to 13/6
Household	25/- to 37/-
Foundry Coke	24/-

SHEFFIELD	Inland.
Best Hand-picked Branch	27/- to 28/-
South Yorkshire Best	23/- to 24/-
South Yorkshire Seconds	18/- to 21/-
Derbyshire Best House	22/- to 23/6
Derbyshire Best Brights	18/- to 20/-
Screened Seconds	17/6 to 19/-
Kitchen Coal	16/6 to 17/6
Best Screened Nuts	17/- to 18/6
Small Screened Nuts	16/- to 16/6
Yorkshire Hards	17/- to 18/-
Derbyshire Hards	17/- to 18/-
Rough Slacks	8/6 to 9/6
Nutty Slacks	7/- to 8/6

Blast-furnace Coke (Inland) 10/- on rail at ovens
Furnace and Foundry Coke (Export), f.o.b., 14/6 to 15/6

CARDIFF— (9) SOUTH WALES.

Steam Coals :	
Best Smokeless Large	19/6 to 19/9
Second Smokeless Large	18/9 to 19/6
Best Dry Large	19/- to 19/6
Ordinary Dry Large	17/9 to 18/3
Best Black Vein Large	18/3 to 18/6
Western Valley Large	17/9 to 18/-
Best Eastern Valley Large	17/7½ to 17/9
Ordinary Eastern Valley Large	17/3 to 17/6
Best Steam Smalls	13/- to 13/6
Ordinary Smalls	11/- to 13/-
Washed Nuts	20/- to 32/-
No. 3 Rhondda Large	19/6 to 19/9
„ „ Smalls	15/- to 16/-
No. 2 „ Large	17/- to 17/3
„ „ Through	15/6 to 16/-
„ „ Smalls	14/- to 14/3
Foundry Coke (Export)	22/6 to 36/6
Furnace Coke (Export)	15/6 to 16/6
Patent Fuel	22/-
Pitwood (ex ship)	19/6 to 20/-
SWANSEA—	
Anthracite Coals :	
Best Big Vein Large	36/- to 38/6
Seconds	27/- to 34/-
Red Vein	22/- to 26/6
Machine-made Cobbles	36/6 to 48/6
Nuts	36/6 to 48/6
Beans	28/6 to 32/6
Peas	19/- to 20/-
Breaker Duff	8/6 to 9/-
Rubbly Culm	8/6 to 9/-
Steam Coals :	
Large	20/- to 20/6
Seconds	18/- to 20/-
Smalls	11/6 to 13/-
Cargo Through	16/- to 17/6

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate : Joists (minimum), 22/6 ; Ordinary Ship, Bridge, and Tank Plates and Sections, 15/-, if home consumers confine purchases from associated British Steel Makers. (*e*) Delivered Black Country Stations.

(*f*) Delivered North-East Coast.

French Engineering Notes.

(From our own Correspondent in Paris.)

Machine Tools.

SINCE the recent formation of the Syndicate of French machine tool makers, a programme has been elaborated for the development of the industry which the syndicate declares should be encouraged and protected on account of its importance in the scheme of national defence. The syndicate now has a membership of about sixty. There is to be a documentation of everything published abroad on the subject of machine tools, and another documentation relating to French machines will be supplied to French users as well as to foreign countries. An inquiry is being made into the needs of home users with a view to seeing how makers can supply the demand for special machines. As regards ordinary machine tools the industry is already protected, and efforts are being made to extend import quotas to cover special machines which are to be constructed mainly under British, German and American licences, so that, if the syndicate succeeds in carrying out its programme, the French industry will cover a wide range of machines that at present have to be imported. Grinding and forging machines are included in the foreign licences which French makers have already secured. Their work will also be aided by the formation of a Superior Committee for the development of French machine tools, which will bring together manufacturers and users for the investigation of all matters affecting the trade and of problems that may have to be solved in the interest of buyers. The Committee will include many experts and directors and chief engineers of the State technical departments.

Oil-electric Locomotives.

The shunting engines employed at the Paris termini are petrol locomotives on the State railways and electric locomotives on the electrified Paris-Orleans line. The P.L.M. Company has recently taken delivery of a 600 horse-power oil-electric shunting engine from Brown Boveri et Cie. This is the first engine of that type employed in France. It is stated that the power of the engine is controlled automatically. Another similar engine, of 800 horse-power, is undergoing trials on the Paris Ceinture railway, where steam locomotives are still running, except on the electrified section between Courcelles and Auteuil. The results of the tests on this line running round the city will be particularly interesting, because that railway, down to 1900, offered the only means of mechanical transport within the city, except a few tramlines with compressed air and steam cars. From that date the traffic of the once flourishing circular railway dwindled through competition from the Metropolitan Railway, until it is now only a shadow of its former self. If the service can be accelerated with oil-electric locomotives there may still be some hope for the old circular railway. Other locomotives of this type are to be built in France by collaboration between the Compagnie Electro-Mécanique, the Aciéries de la Marine et d'Homécourt and Alsthom.

Machinery Import Quotas.

For some months past French and German manufacturers have been carrying out negotiations for reciprocal agreements involving an adjustment of exchanges between the two countries. They have usually been satisfactory to both sides, and in most cases they have received official sanction. Similar negotiations are now in progress between the Syndicat des Industries Mécaniques de France and the Fédération Mécanique, and the Verein Deutsche Maschinenbau Anstalten. The meetings are being held in Liége. It is understood that several agreements have been reached for adjusting the imports of German machinery into France and of French mechanical products into Germany. Such negotiations are indispensable at a time when Germany has laid an embargo on the export of capital, because they allow of some arrangement being come to for the payment of French goods imported into that country. So far, arrangements between industrial groups have alone provided a system of reciprocal exchanges which has worked smoothly and has permitted manufacturers in the countries concerned to participate in a necessarily limited business under more favourable conditions than would be otherwise possible. At the same time, the quotas are to the advantage of the countries with which arrangements are made, and manufacturers of the same classes of goods in other countries risk getting less favourable treatment.

Unemployed Engineers.

The Union des Syndicats d'Ingénieurs, which unites all the associations of engineers in France, has again issued a warning against the swelling of their ranks at a time when there is no employment for those who are leaving engineering schools with diplomas. Since the Union made its first appeal to parents to abstain from sending their sons into an overcrowded profession, the situation has become seriously worse, and it, therefore, exhorts directors of engineering schools to limit the number of students and the diplomas granted. Of the 60,000 engineers in this country, the majority are prepared to undertake any work outside their profession.

The Steel Cartel.

At a meeting in Brussels on Friday last of presidents of the steelmakers' unions in Belgium, France, Germany, Luxemburg, and Saar, it was decided to renew the Steel Cartel for another five years on condition that the Belgian group is able to secure the adhesion of the one firm that is still remaining outside. It is believed that Government action may be necessary to secure this result. Another meeting will be held in Luxemburg this week to discuss further the question of quotas for foreign trade, and then the creation of a central sales organisation will be considered, so that under the most favourable conditions the Cartel can hardly come into operation for some time.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

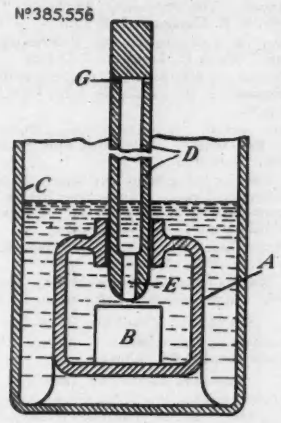
The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

SWITCHGEAR.

385,556. July 29th, 1932.—ELECTRIC SWITCHES OR CIRCUIT BREAKERS, *International General Electric Company, Incorporated, of* 120, *Broadway, New York, U.S.A.*

This invention enables excess pressure within the explosion chamber of a circuit breaker to be relieved without complicated mechanism. A is the explosion chamber with the fixed contact B, which is contained in a receptacle C filled with the liquid under which the contacts separate. An insulating liquid can be employed, or a conductive liquid, such as water, may be used. The movable contact D is made hollow and connects with the chamber by a passage E. The movable contact may be constituted as an open-ended tube, and in this case, since the volume of metal at the lower end of the contact is comparatively small, an arcing tip may be provided. On the raising of the

Nº385,556



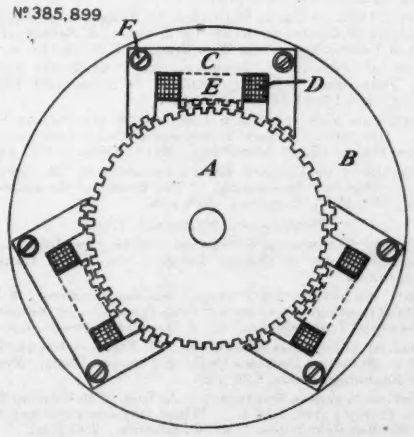
movable contact it is conceivable that some of the liquid lying in its lower part might be taken up with it through the passage E, and in some circumstances still more liquid be forced into the hollow space, so that the latter would gradually become filled with liquid, thus preventing the formation of the desired air pocket. In order to prevent this, air holes G are preferably provided at the upper end of the contact D, which are always open to the atmosphere above the liquid level and maintain the level of the liquid within the pin always at the same height as that in the receptacle C. The air holes G must, however, be so developed that the sum of their cross sections is substantially smaller than the cross section of the opening E, in order that a buffer effect is present, due to the cushion of enclosed air.—*December 29th*, 1932.

DYNAMOS AND MOTORS.

385,899. August 4th, 1932.—ELECTRIC MOTORS, International General Electric Company, Incorporated, 120, Broadway, New York, U.S.A.

This invention relates to synchronous motors, particularly for driving gramophones. Motors of this kind possess the advantage that no special devices are required for maintaining their speed constant and the toothed rotor has no winding. The stator, which is likewise provided with teeth or notches, is equipped with an exciter winding fed with A.C. In order to construct machines of this kind as economically as possible and to reduce the current consumption to a minimum, a comparatively small air gap is provided. It is very difficult to obtain in practice a small air gap which is uniform around the whole periphery, owing to inaccuracies occurring in manufacture. For this reason such motors set up disturbing noises

Nº385,899



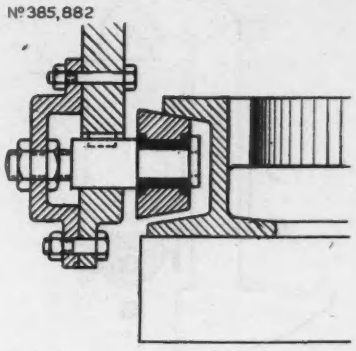
when in operation which may be attributed to the irregular development of the magnetic field due to the lack of uniformity of the air gap. This disadvantage is overcome, according to the invention, by mounting the laminated pole cores of the stator, which are provided with notches on the inner periphery, so that they can slide in a radial direction, *e.g.*, upon a base plate. In the form of construction shown the rotor A of the motor is provided around its periphery with uniformly arranged teeth which are distributed in accordance with the desired speed of rotation and the available supply frequency. A number of magnet cores C are mounted upon a base plate B around the rotor A. The cores C carry exciter windings D fed with A.C., and consist of laminated iron provided on the inner circumference with notches E. The distribution of the teeth on the pole cores is the same as that on the rotor. The cores C are fixed to the base plate B by means of screws F, which are passed through holes in the cores. The diameter of the holes is so great as to afford a small displacement of the cores C in a radial direction on the base plate B, and at the same time an accurate adjustment of the small air gap when disturbing noises are set up. By means of this arrangement it is possible to obtain a perfectly symmetrical and uniform distribution of the magnetic field and the magnetic noise can be entirely or, for the greater part, eliminated.—*January 5th*, 1933.

CRANES AND CONVEYORS.

385,882. July 8th, 1932.—TURNTABLE ROLLERS, Orenstein und Koppel Ag., Tempelhofer Ufer 23/24, Berlin, S.W., Germany.

In this crane the excentric load on the turntable is taken up by conical rollers which run, with small clearance between the

Nº385,882



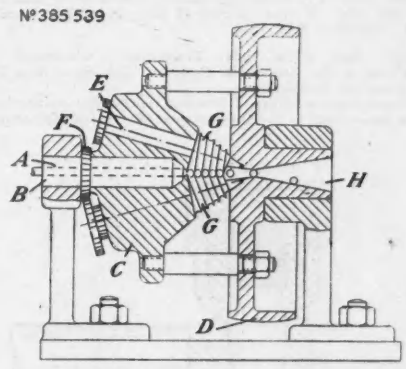
two flanges of the foundation ring. In order to maintain a small clearance, so that the crane will not rock, the rollers can be adjusted axially, and, as a consequence of their conical form, take up any slackness. The crane can be centred on the ring either by a short king post, or by a second set of rollers engaging the periphery of the ring.—*January 5th*, 1933.

MACHINE TOOLS AND SHOP APPLIANCES.

385,539. June 28th, 1932.—MAKING METAL BALLS, T. Möller, Nusgerstrasse 3, Fulda, Germany.

This invention concerns a process of making metallic balls from rolled stock bar. The bar is introduced into the machine at A through a stationary mandrel B, round which there is revolved

Nº385 539

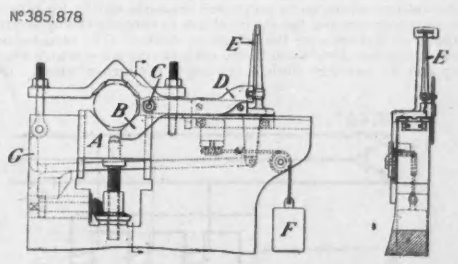


a cage C by means of the belt pulley D. This cage contains a set of three spindles, one of which is shown at E. Gears on these spindles mesh with the fixed sun wheel F and consequently rotate the grooved rolls G G. These rolls mould the bar into spheres, which are separated and are discharged from the orifice H.—*December 29th*, 1932.

385,878. July 5th, 1932.—CRANK PIN GRINDING MACHINES, The Churchill Machine Tool Company, Limited, Broadheath, near Manchester, and H. H. Asbridge, Claremont, Washway-road, Ashton-on-Mersey.

The object of this invention is to facilitate the setting of a crank axle in the centre of the grinding machine while the crank pins are ground. The axle is supported in V blocks A,

Nº385,878



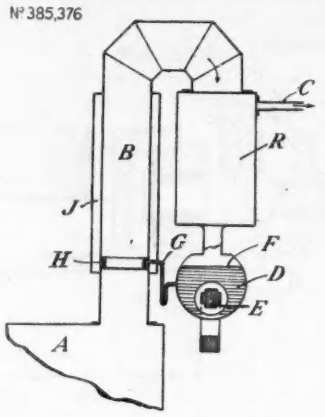
which can be raised and lowered by the gear shown. Engaging with the back of the axle there is another V marked B. This V is pivoted at C, and has a backward extension D, which operates the indicating pointer E. This pointer is in full view from the front of the machine and shows when the axle is central. The V and the pointer are mounted on a slide and are pulled up to the axle by the weight F, while the handle G serves to push it back out of the way.—*January 5th*, 1933.

MISCELLANEOUS.

385,376. October 10th, 1931.—VACUUM PUMPING SYSTEMS, The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C.2; and John Carley Read, of The Gable House, Bilton, Rugby.

In vacuum pumping systems for mercury are rectifiers when high pumping speeds are necessary it is essential to reduce the frictional resistance in the pipe connecting the rectifier chamber

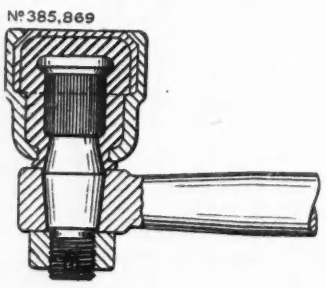
to the mercury vapour vacuum pump to a minimum, and this is generally accomplished by making the connecting conduit as short and of as large a cross sectional area as practicable. With this arrangement, however, there is always the danger that mercury will gradually distil over from the pump to the rectifier or *vice versâ*, ultimately causing the pump to cease operating in the proper manner. The object of the invention is to overcome the trouble. The pump extracts air from the rectifier A, through the suction pipe B, which is made as wide and short as possible in order to obtain the maximum possible pumping speed. The air is expelled from the mercury pump towards the rough vacuum pump through the outlet pipe C. The mercury boiler D, which may be heated in any convenient manner, such as by induction by means of the transformer core E passing through it, has its mercury level F kept approximately at a constant level. For this purpose a small pipe G is led to the collecting trough H in the main suction pipe B. The suction



pipe is provided with a water jacket J which cools the region of the collecting trough and also a considerable part of the pipe above the latter. The suction pipe and the mercury pump are maintained at a temperature generally below that of the rectifier, so that there is a tendency for mercury to distil over slowly into them. Some of the mercury condensed in this way will condense in the pump itself, but most of it will condense in the water-cooled section of the suction pipe and will run down into the collecting trough. Consequently the collecting trough will tend to remain full and surplus mercury will run over, back into the rectifier. Owing to the connecting pipe G the mercury level in the pump will be maintained at a level governed by the level at which the mercury overflows from the trough H. As it is essential that there shall be no rapid evaporation of mercury from the trough H due to heat transmitted to it from the mercury boiler, the connecting pipe G is made small and fairly long, and may be water cooled at the end remote from the boiler.—*December 29th*, 1932.

385,869. June 27th, 1932.—FLEXIBLE CONNECTIONS, *The Firestone Tyre and Rubber Company, Ltd., Great West Road, Brentford, Middlesex.*

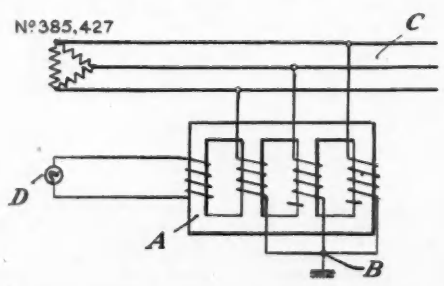
In accordance with this invention the flexible connection in such a mechanism as the steering gear of a motor car comprises



a socket having a rubber member mounted therein and frictionally restrained from movement relative thereto or vulcanised thereto, and a stud having one end completely embedded in the rubber member and vulcanised thereto, to provide a yieldable connection between movable members connected respectively to said stud and socket.—*January 5th*, 1933.

385,427. December 23rd, 1931.—ELECTRIC TRANSFORMER FOR USE IN SUPERPOSING SINGLE-PHASE CONTROL CURRENTS OR IMPULSES ON TO ALTERNATING CURRENT NETWORKS, Landis and Gyr S.A., of Hofstrasse 1, Zug, Switzerland.

This invention relates to the superposition of single-phase alternating current on to polyphase networks chiefly for remote control purposes and has for its object to simplify the apparatus employed and increase the efficiency thereof. The transformer core comprises three main limbs, each having a secondary winding and an auxiliary limb A bearing a primary winding. The



secondary windings are star-connected, these being connected at one end to a neutral point B, which is earthed. The other ends are each connected to a phase of a three-phase network extending into a delta-connected winding. The primary winding is in series with the generator D. In order to tune the three-phase network and the superposition members to the control frequency, and also to protect the control generator from equalising currents of low frequency due to lack of symmetry in the voltages between the different parts of the network, a condenser can be connected in the generator circuit. By the star connection of the secondary windings it is rendered possible for the vectorial sum of the three-phase flux to be zero in the yokes of the core. Consequently the auxiliary limb A cannot carry any low-frequency magnetic flux. The single-phase flux produced by the primary winding and emanating from the auxiliary limb A is, on the other hand, distributed in equal parts on to the three main limbs. The pressures induced in the secondary windings are therefore transmitted in the same magnitude to their corresponding phase conductors. Thus by the choking of the three-phase currents there is only a coupling between the primary winding and the secondary windings in respect of the single-phase control current.—*December 29th*, 1932.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Monday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

CHEMICAL ENGINEERING GROUP.—In Rooms of Chemical Soc., Burlington House, W.1. "Creep in Steels," Mr. H. J. Tapsell. 8 p.m.

INST. OF ELECTRICAL ENGINEERS: N.E. STUDENTS.—Armstrong College, Newcastle-upon-Tyne. "Modern Aspects of the Mercury Arc Rectifier," Mr. H. H. Taylour. 7.15 p.m.

INST. OF METALS.—The University, Sheffield. "Soft Solders and Fluxes," Dr. O. F. Hudson. 7.30 p.m.

JUNIOR INST. OF ENGINEERS.—39, Victoria-street, S.W.1. "Oil from Coal," Dr. C. H. Lander. 7.30 p.m.

KEIGHLEY ASSOC. OF ENGINEERS.—Queen's Hotel, Keighley. "Synthetic Ammonia: Its Production and Uses," Mr. G. W. Young. 7.30 p.m.

MANCHESTER ASSOC. OF ENGINEERS.—Engineers' Club, Albert-square, Manchester. "Patterns and Patternmaking," Mr. E. Longden. 7.15 p.m.

N.E. COAST INST. OF ENGINEERS AND SHIPBUILDERS.—Bolbec Hall, Newcastle-upon-Tyne. "Destroyer Forms," Mr. J. L. Scott. "Approximating E.H.P.: Notes of Amendments to Data Given in 1927 Paper," Mr. A. L. Ayre.

ROYAL INST. OF GREAT BRITAIN.—21, Albemarle-street, W.1. Discourse, Mr. A. V. Hill. 9 p.m.

SHEFFIELD METALLURGICAL ASSOCIATION.—Royal Victoria Hotel, Sheffield. Supper-dance. 7.30 p.m. to 1 a.m.

SATURDAY, FEBRUARY 11TH.

INST. OF ELECTRICAL ENGINEERS: N. MIDLAND STUDENTS.—Visit to the Leeds General Post Office.

MONDAY, FEBRUARY 13TH.

BRADFORD ENGINEERING SOC.—Technical College, Bradford. "Industrial Lighting," Mr. A. Atkinson. 7.30 p.m.

INST. OF ELECTRICAL ENGINEERS: N.-EASTERN.—Armstrong College, Newcastle-upon-Tyne. "An Analysis of the Costs of Electricity Supply and Distribution in Great Britain, with some Suggestions as to the Causes of and Remedies for the Slow Rate of Development," Mr. J. M. Kennedy and Miss D. M. Noakes. 7 p.m.

INST. OF METALS.—At 39, Elmbank-crescent, Glasgow. "Modern Light Alloys, with Particular Reference to Corrosion," Dr. Leslie Aitchison. 7.30 p.m.

TUESDAY, FEBRUARY 14TH.

CO-ORDINATING COMMITTEE.—Girls' High School, Dudley. "Instrument Control in the Iron and Steel Industries," Mr. J. B. Fortune. 7 p.m.

ILLUMINATING ENGINEERING SOC.—At Inst. of Mechanical Engineers, Storey's-gate, S.W.1. "Every-day Photometry by Photo-electric Cells," Dr. J. W. T. Walsh. 7 p.m.

INST. OF AUTOMOBILE ENGINEERS.—King's Head Hotel, Coventry. "Some Problems in Chassis Design," Mr. L. H. Dawtrey. 7.45 p.m.

INST. OF ELECTRICAL ENGINEERS: N. MIDLAND STUDENTS.—Hotel Metropole, Leeds. "Railway Electrification," Mr. R. N. Kinder. 7.15 p.m.

INST. OF ELECTRICAL ENGINEERS.—Royal Technical College, George-street, Glasgow, C.1. Tour through the Electrical Engineering Laboratories, arranged by Professor S. Parker Smith. 7.30 p.m.

INST. OF MARINE ENGINEERS.—The Minories, E.C.3. "The Modern Trend in Marine Steam Practice," Mr. John Neill. 6 p.m.

INST. OF METALS.—Armstrong College, Newcastle-upon-Tyne. "Refractory Materials and the Non-ferrous Industries," Mr. A. B. Searle. 7.30 p.m.

INST. OF METALS.—Y.M.C.A., Swansea. "Platinum Metals," Mr. R. H. Atkinson. 6.15 p.m.

ROYAL INST. OF GREAT BRITAIN.—21, Albemarle-street, W.1. "Analysis of Crystal Structure by X-rays: A Review of the Work of Twenty Years," Sir Wm. Bragg, F.R.S. 5.15 p.m.

INST. OF PETROLEUM TECHNOLOGISTS.—At Royal Soc. of Arts, John-street, Adelphi, W.C.2. "Candles and Candle Making," Mr. David Allan. 5.30 p.m.

SHEFFIELD METALLURGICAL ASSOC.—198, West-street, Sheffield. Discussion, "Heat Treatment without Detriment to Surface Finish (Bright Annealing)," Mr. J. Fallon. 7.30 p.m.

UNIVERSITY OF LONDON, KING'S COLLEGE, W.C.2.—Department of Electrical Engineering. "The Theory of the Induction Motor," Dr. F. T. Chapman. 5.30 p.m.

WEDNESDAY, FEBRUARY 15TH.

INST. OF AUTOMOBILE ENGINEERS.—Metropole Hotel, Leeds. "Some Problems in Chassis Design," Mr. L. H. Dawtrey, 7.15 p.m.

INST. OF CIVIL ENGINEERS.—Gt. George-street, S.W.1. Informal meeting. Discussion, "Ship Propulsion by Mechanical or Electrical Transmission," Mr. J. Hamilton Gibson. 6 p.m.

INST. OF ELECTRICAL ENGINEERS: N. MIDLAND STUDENTS.—Visit to Montague Burton's Clothing Factory, Leeds. Meet at Corn Exchange, Leeds, 2.30 p.m.

INST. OF WELDING ENGINEERS.—At Inst. of Mechanical Engineers, Storey's-gate, S.W.1. "Where Oxy-acetylene and Electric Welding Join Forces," Mr. O. Simonis. 7.45 p.m.

NEWCOMEN SOC.—At the Hall of the Chartered Inst. of Patent Agents, Staple Inn Buildings, W.C.1. "The Marquis of Worcester and Vauxhall," Mr. W. H. Thorpe; "The Shetland Water Mill," Mr. H. W. Dickinson and Mr. E. Straker. 5.30 p.m.

N.E. COAST INST. OF ENGINEERS AND SHIPBUILDERS: GRADUATES.—Bolbec Hall, Newcastle-upon-Tyne, 1. "Ship Repairing," Mr. A. T. S. Sheffer. 7.15 p.m.

ROYAL METEOROLOGICAL SOC.—49, Cromwell-road, S. Kensington, S.W.7. "Atoms, Molecules, and the Atmosphere," Prof. S. Chapman, F.R.S. 5.15 p.m.

ROYAL MICROSCOPICAL SOC.—B.M.A. House, Tavistock-square, W.C.1. Meeting. 5.30 p.m.

THURSDAY, FEBRUARY 16TH.

INST. OF ELECTRICAL ENGINEERS.—Grosvenor House, Park-lane, W.1. Annual dinner and reunion. 7 p.m. for 7.30 p.m.

INST. OF STRUCTURAL ENGINEERS.—Hotel Metropole, Leeds. "Some Notes on Floor Construction," Mr. E. S. Andrews. 7 p.m.

N.E. COAST INST. OF ENGINEERS AND SHIPBUILDERS: TEESSIDE BRANCH.—Cleveland Scientific and Technical Inst., Corporation-road, Middlesbrough. "Electric Welding," Mr. J. H. Paterson. 7.30 p.m.

ROYAL AERONAUTICAL SOC.—At Royal Soc. of Arts, John-street, Adelphi, W.C.2. "Cloud Formation and its Effect upon Gliding," Sir Gilbert T. Walker, F.R.S. 6.30 p.m.

FRIDAY, FEBRUARY 17TH.

INST. OF CHEMICAL ENGINEERS.—Hotel Victoria, Northumberland-avenue, W.C.2. Eleventh annual meeting and annual dinner. Annual meeting, 11 a.m. Presidential address, "Chemical Engineering and the Soap Industry," the Rt. Hon. the Viscount Leverhulme, 11.45 a.m. Luncheon, 12.45 p.m. "Metallurgy from the Standpoint of the Chemical Engineer," Mr. L. Singlehurst-Ward, 2.15 p.m. King Edward VII. Rooms, annual dinner, 7 for 7.30 p.m.

INST. OF MECHANICAL ENGINEERS.—Storey's-gate, St. James's Park, London. Annual general meeting. The Annual Report of the Council will be presented. Declaration of Election of Council. Paper for discussion, "The Production of a Vacuum in an Air Tank by Means of a Steam Jet," Mr. F. R. B. Watson. 5.30 p.m.

INST. OF SANITARY ENGINEERS.—Caxton Hall, S.W.1. Sessional meeting. 6 p.m.

JUNIOR INST. OF ENGINEERS.—39, Victoria-street, S.W.1. "Episodes, Both Grave and Gay, in Engineering History," Eng.-Captain E. C. Smith. 7.30 p.m.

MANCHESTER ASSOC. OF ENGINEERS.—Engineers' Club, 17, Albert-square, Manchester. Annual dinner. 6.45 p.m. for 7.15 p.m.

RAILWAY CLUB.—57, Fetter-lane, E.C.4. Annual general meeting. Presidential address. 7.30 p.m.

ROYAL INST. OF GREAT BRITAIN.—21, Albemarle-street, W.1. Discourse, Mr. J. Dover Wilson. 9 p.m.

SATURDAY, FEBRUARY 18TH.

ROYAL INST. OF GREAT BRITAIN.—21, Albemarle-street, W.1. "Detection and Production of Swift Particles," Lord Rutherford, F.R.S. 3 p.m.

MONDAY, FEBRUARY 20TH.

BRADFORD ENGINEERING SOC.—Joint meeting with the Technical College, Technical College, Bradford. "Lubrication of Internal Combustion Engines," Mr. A. E. Lawson. 7.30 p.m.

ENGINEERS' GERMAN CIRCLE.—At Inst. of Mechanical Engineers, Storey's-gate, S.W.1. "New Developments in the Design of Rolling Mill Equipment," Herr Dip.-Ingenieur Ernst Kugel. 6 p.m.

INST. OF AUTOMOBILE ENGINEERS.—At 39, Elmbank-crescent, Glasgow. "An Experimental Investigation of Flow in Oil-engine Injection Systems," Dr. S. J. Davies. 7.30 p.m.

WOLVERHAMPTON AND DISTRICT ENGINEERING SOC.—Victoria Hotel, Wolverhampton. "Modern Developments in Bridge Building," Mr. F. H. Abrahams. 7.30 p.m.

MONDAY, FEBRUARY 20TH, TO FRIDAY, MARCH 3RD.

BRITISH INDUSTRIES FAIR, 1933.—London and Castle. Bromwich, Birmingham. Daily.

TUESDAY, FEBRUARY 21ST.

INST. OF AUTOMOBILE ENGINEERS.—Victoria Hotel, Wolverhampton. "Some Problems in Chassis Design," Mr. L. Dawtrey. 7.30 p.m.

OLD CENTRALIANS.—Devereux Restaurant, Devereux-court, W.C.2. Luncheon. 1 p.m.

SHEFFIELD METALLURGICAL ASSOC.—198, West-street, Sheffield. "Spring and Spring Steels," Mr. H. W. Webster. 7.30 p.m.

UNIVERSITY OF LONDON, KING'S COLLEGE, W.C.2.—Department of Electrical Engineering. "The Theory of the Induction Motor," Dr. F. T. Chapman. 5.30 p.m.

WEDNESDAY, FEBRUARY 22ND.

INST. OF AUTOMOBILE ENGINEERS.—At Engineers' Club, Albert-square, Manchester. "Some Problems in Chassis Design," Mr. L. H. Dawtrey. 7 p.m.

INST. OF ELECTRICAL ENGINEERS: N.-EASTERN.—At Literary and Philosophical Society, Westgate-road, Newcastle-upon-Tyne. Faraday Lecture, "Lightning—and how the Engineer Deals with its Effects," Professor J. T. MacGregor-Morris. 7 p.m

FRIDAY, FEBRUARY 24TH.

INST. OF PROFESSIONAL CIVIL SERVANTS.—At Royal Soc. of Arts, John-street, Adelphi, W.C.2. "Air Photography and Archæology," Mr. O. G. S. Crawford. 5.30 p.m.

JUNIOR INST. OF ENGINEERS.—39, Victoria-street, S.W.1. "Smoke Detection and Measurement," Major C. E. Prince. 7.30 p.m.

SATURDAY, FEBRUARY 25TH.

INST. OF MUNICIPAL AND COUNTY ENGINEERS: S. EASTERN DISTRICT MEETING.—At Purley. Assemble Council Offices, Purley. 11 a.m

MONDAY, FEBRUARY 27TH.

INST. OF MECHANICAL ENGINEERS: GRADUATES' SECTION.—Storey's-gate, S.W.1. "Plain Bearings," Mr. J. Robinson. 6.45 p.m.

TUESDAY, FEBRUARY 28TH.

INST. OF ELECTRICAL ENGINEERS.—North British Station Hotel, Edinburgh. "Present Practical Limits of Power Station Efficiency," Mr. W. S. Burge. 7 p.m.

INST. OF FUEL.—Technical College, Green-lane, Derby. "Survey of Modern Tendencies in Boiler Design," Mr. F. Dransfield. 7 p.m.

SHEFFIELD METALLURGICAL ASSOC.—198, West-street, Sheffield. "Some Unusual Methods of Analysis," Mr. T. R. Walker. 7.30 p.m.

FRIDAY, MARCH 3RD.

INST. OF MECHANICAL ENGINEERS.—Storey's-gate, S.W.1. Informal meeting. Discussion, "Modern Steam Propulsion for Ships," to be introduced by Major William Gregson. 7 p.m.

JUNIOR INST. OF ENGINEERS.—39, Victoria-street, S.W.1. "Virtues and Vices of Some Metals," Mr. W. E. W. Millington. 7.30 p.m.

SUNDAY, MARCH 5TH, TO SUNDAY, MARCH 12TH.

LEIPZIG SPRING FAIR.—Daily.

MONDAY, MARCH 6TH.

ROYAL SOC. OF ARTS.—John-street, Adelphi, W.C.2. Cantor Lecture. "Welding and Allied Processes for Engineering Purposes," Mr. Arthur Stephenson. 8 p.m.

WEDNESDAY, MARCH 8TH.

INST. OF FUEL.—At Chemical Society's Rooms, Burlington House, W.1. "Three Coal Cleaning Processes New to British Practice." 6 p.m.

INST. OF FUEL.—At Engineers' Club, Albert-square, Manchester. "Use of Refractories in the Fuel Industries," Mr. Colin Presswood. 7 p.m.

INST. OF METALS.—Trocadero Restaurant, Piccadilly Circus, W.1. Annual dinner and dance. 7 p.m.

Periodical

Engineer Feb 10, 1933

MOVING FORMS APPLIED TO THE CONSTRUCTION OF REINFORCED CONCRETE BUILDINGS

CONSTRUCTION OF A SILO WITH CIRCULAR BINS

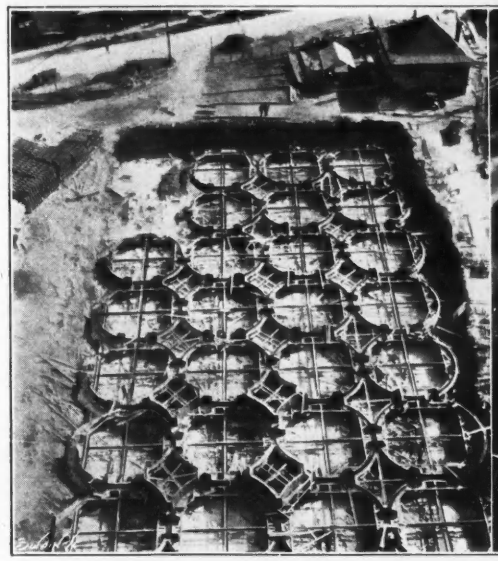


Fig. I.—Forms in Course of Construction.

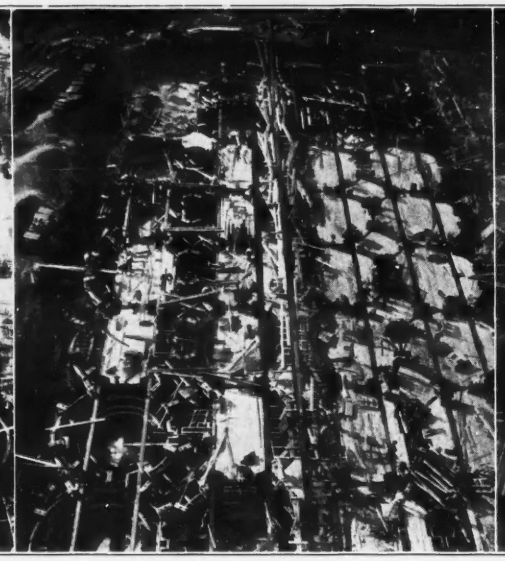


Fig. II.—Forms Partially Floored.

Fig. III.—Forms Nearing Completion.

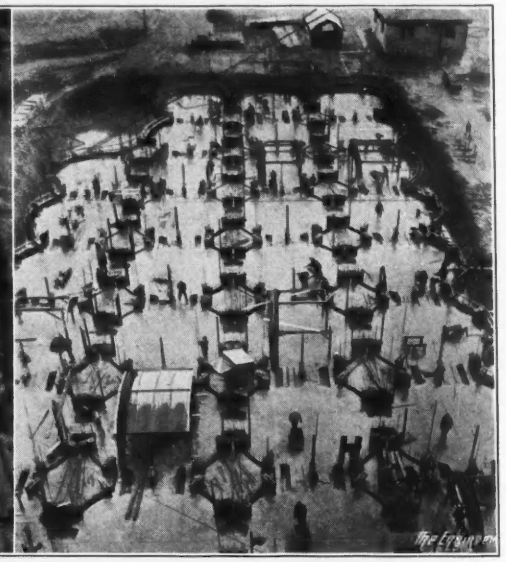


Fig. IV.—Forms Completed. Pouring just begun.

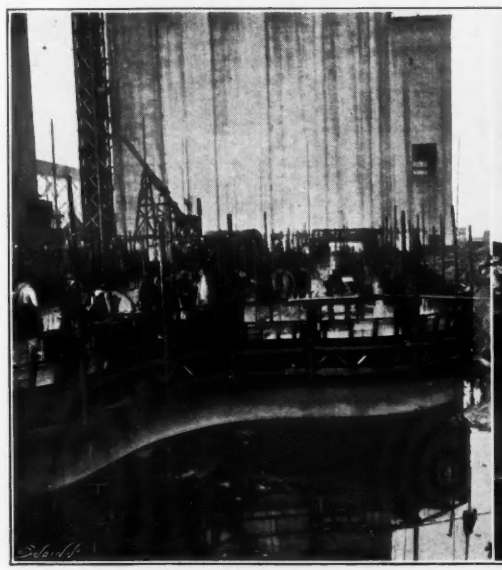


Fig. V.—Progress during First Day. Wall Visible below Forms.

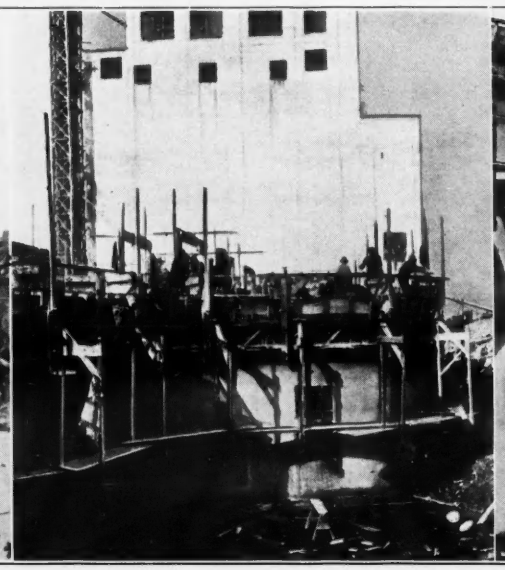


Fig. VI.—Third Day. Showing Metal Casements in Position.

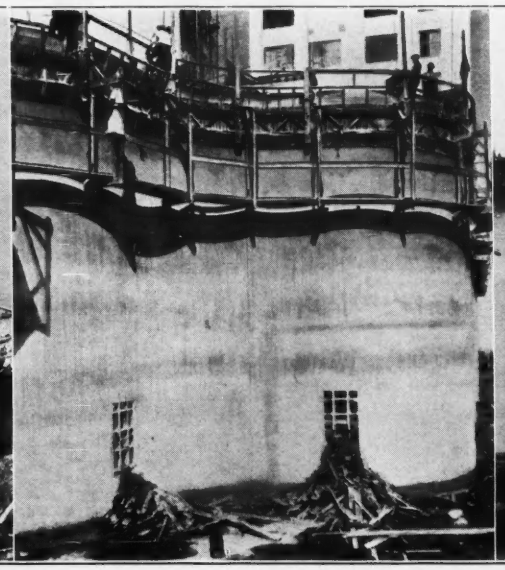


Fig. VII.—Sixth Day. Showing Pointing-up Platforms.

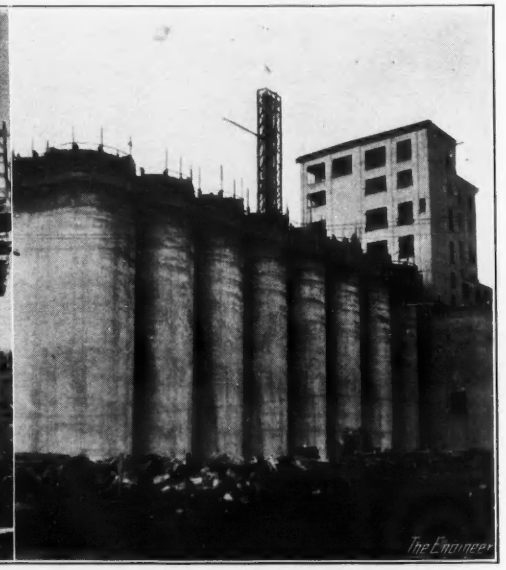


Fig. VIII.—Fifteenth Day. Pouring Finished. Height 115ft.

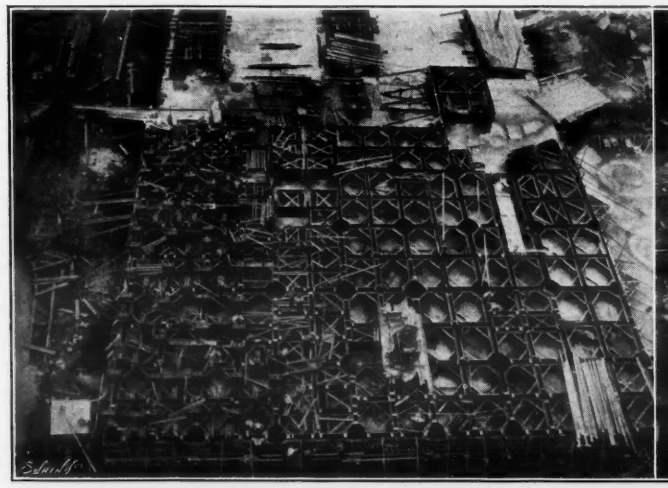


Fig. IX.—Forms being Assembled.

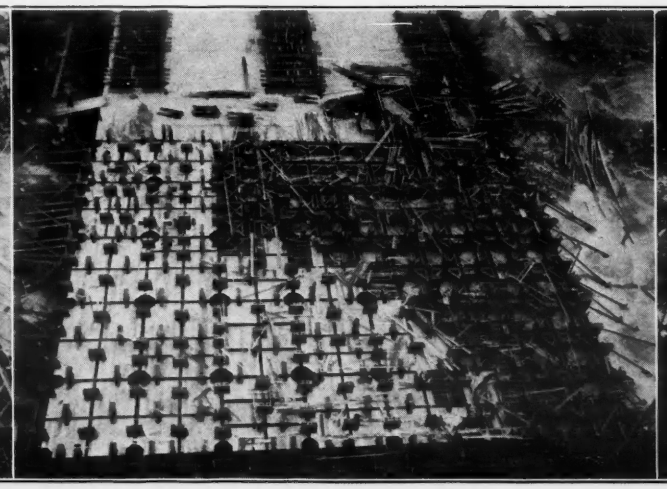


Fig. X.—Forms Partially Floored.

Fig. XI.—Upper Floor Completed. Ready for Pouring.

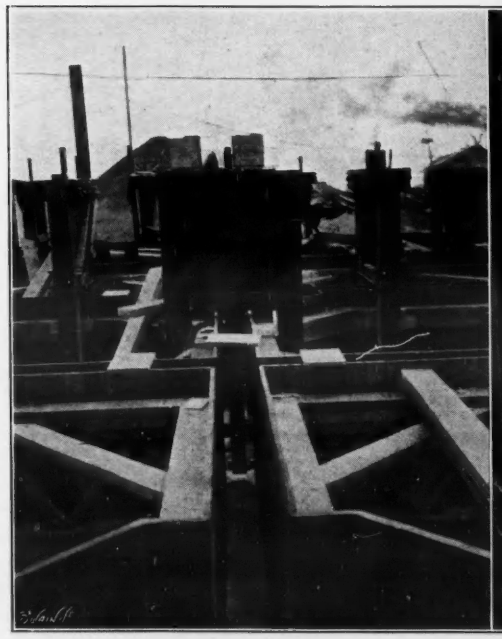


Fig. XII.—Detail of Forms showing Frames, Sheeting, Yokes and Jacks.

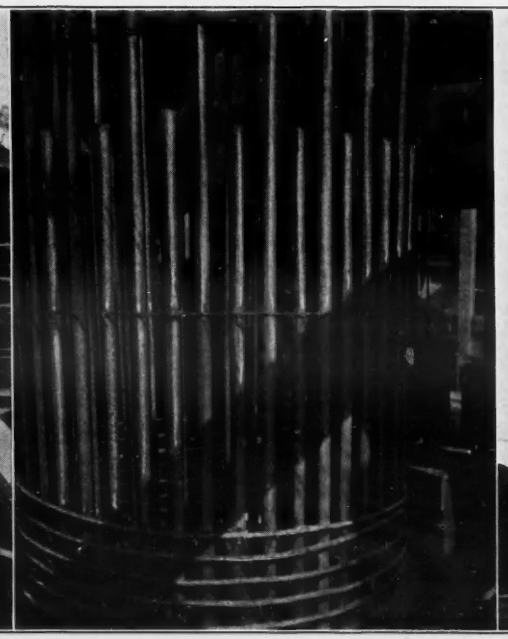


Fig. XIII.—Reinforcing Steel for one of the Main Columns.

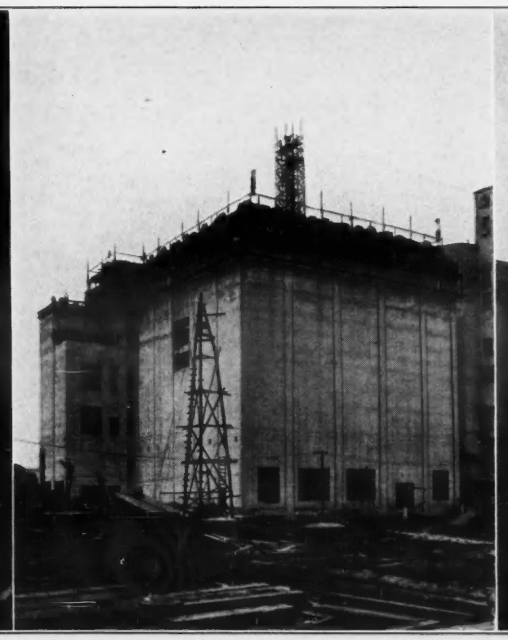


Fig. XIV.—Building after Pouring had been in Progress 14 days.

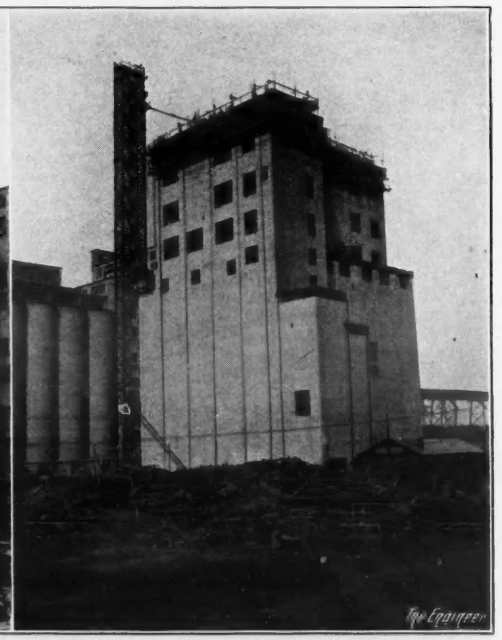


Fig. XV.—Building Complete. Elevation 187ft. Time 29½ days.

A Seven-Day Journal

The R.A.F. Non-stop Flight.

STARTING at 7.12 a.m. on Monday, February 6th, a specially built Fairey-Napier long-distance monoplane, piloted by Squadron-Leader Gayford and Flight-Lieut. Nicholetts, landed at Walvis Bay, on the West Coast of Africa at 4.40 p.m. on the following Wednesday, having flown 5411 miles non-stop in 57½ hours. The distance covered on a great circle course was 5340 miles, which exceeds the previous record of 5017 miles non-stop by 323 miles. The original intention was that the machine should land at Cape Town, but owing to strong southerly winds the petrol supply ran short and necessitated a landing at Walvis Bay. It will be remembered that the machine was fitted with an automatic control, known as the "Robot Pilot." A harmattan haze, which consists of a thick dust blown out by the north-east wind, met with over Nigeria, was probably responsible for the failure of this automatic control during the Tuesday night. According to the Air Ministry, the primary object of the R.A.F. in organising the flight was to gain technical information and experience which would be of value in determining the type of service aircraft best fitted for reinforcing air units in distant parts of the Empire without intermediate landings. Much of the development work which has had to be undertaken in order to build this record-breaking aircraft is directly applicable to other types of machine. The capture of the long-distance record means that Great Britain now holds three aviation records—for altitude, speed, and distance—at 43,976ft., 407·5 miles per hour, and 5340 miles respectively.

The F.B.I. and Industry.

A MEMORANDUM issued by the Federation of British Industries last Thursday, February 9th, sets out the views of that Federation as to the monetary policy this country should pursue. Before issue, the memorandum was unanimously approved by the Executive Committee, and it was decided that a copy should be sent to the Chancellor of the Exchequer. The Federation, it is stated, has never regarded the depression as a purely monetary phenomenon, but it is of the opinion that many of our present basic difficulties are caused by the fact that since the war financial policy has become divorced from commercial and industrial policy, with grave detriment to the latter. The reasons why this opinion is held are expressed at considerable length in the memorandum, which subsequently states that the Federation holds that no steps should be taken to return to the gold standard until there is full assurance that it will serve the industrial needs of Great Britain and the Empire. Immediate efforts should be directed to building up a British system based primarily on the Empire in the hope that this may provide a reasonable measure of stability and prosperity, and, in due course, form the nucleus of a new world financial system. British policy must now consciously adopt a new plan, duly subordinated to and co-ordinated with commercial and industrial policy.

Coal-Oil for the Navy.

IT was officially announced on Thursday of last week that a contract for twelve months' bulk supplies of oil made from British coal had been placed by the Admiralty with Low Temperature Carbonisation, Ltd. The contract, it is stated, follows two years' secret research and trial on land and sea conducted by Low Temperature Carbonisation, Ltd., in co-operation with the Admiralty engineering and chemical departments, with a view to standardising a fuel distilled from British coal which will fulfil the very exacting requirements of modern naval vessels. A final specification of coalite oil-fuel was drawn up in 1932, and on December 5th the first bulk consignment was delivered to the Admiralty for H.M.S. "Westminster." Exhaustive trials just completed at sea by H.M.S. "Westminster," using the new fuel, have, it is stated, been most satisfactory. Preliminary calculations show that the cruising radius of the vessel, which has hitherto used ordinary petroleum oil, will be increased by the new oil—a result of very great importance from the naval standpoint. No modifications of the vessel's standard equipment were required for the use of the new fuel. The oil, which is manufactured commercially as a by-product in the production of smokeless fuel, is being supplied to the Admiralty at a price which compares favourably, it is stated, with standard prices charged round the coast for first-class bunker petroleum oils.

The London Power Company.

SPEAKING at the annual general meeting of the London Power Company on Friday, February 10th, the chairman, Sir Francis Fladgate, explained that in spite of the continued national depression, 1,008,264,304 units were generated by the company during the year 1932. The output from the stations was 963,405,452 units, an increase of 7·08 per cent. over the previous year. Substantial supplies were given to the Central Electricity Board from the Willesden, Grove-road, and Deptford West stations. It was a matter of satisfaction to be able to point to the accuracy of the company's forecast. In 1924 the average operating cost of the constituent companies was 0·55d. per unit, and it was stated that it was hoped by 1929 to reduce that figure by 50 per cent. For 1931 the cost was 0·217d. per unit, and for last year 0·202d. That showed a greater reduction than 50 per cent., but the comparison had to be qualified by reducing the price of coal, which in 1924 was approximately 27s. 7d. per ton, while to-day it averaged 17s. 7d. per ton. It would be seen that the saving on works costs had been very material, and though the capital outlay had been very great, the comparison of total costs between the two periods had been quite satisfactory, namely, 0·9723d. per unit in 1926, 0·5608d. in 1931, and 0·5279d. in 1932. The Board look with confidence to further economies being secured when the Battersea station took its place in commercial operation with the remaining interconnected stations of the company. The experiments made by the company's chemists on flue gas washing had been brought to a successful issue, and the experimental plant at Grove-road had been dismantled. The necessary apparatus for the washing of the flue gases at Battersea was being installed.

Unemployment Relief Works.

IN reply to a letter from the Bethnal Green Borough Council, the Prime Minister has given the Government's reasons for discontinuing "the policy of attempting to deal with unemployment by a system of State-assisted relief works." Mr MacDonald remarks that as long as the depression in industry appeared to be of a temporary nature, that policy was quite proper, but when "it became evident that the heavy unemployment from which the country was suffering had its roots in world causes, there was no longer any justification, especially in view of its now evident ineffectiveness, for continuing the policy of relief works, which by reason of the burdens it imposes on the finances of the State and local authorities—and so ultimately on industrial enterprises and activities—could only serve to reduce the competitive power of British industry and to delay its ultimate recovery. Instead, the Government has directed its policy towards a revival of ordinary industrial activity by creating the conditions under which industry can thrive." The Prime Minister then alludes to the Conversion Scheme, tariffs, and the Ottawa Agreements, and concludes by a review of indications which seem to justify a belief that the new policy is being effective, and that recovery, even in the heavy industries, has begun. It is hardly necessary to add that the Borough Council of Bethnal Green disagrees with the Government's policy.

Gasometer Explosion.

WHILST it is desirable to put on record the violent explosion of a gasometer at Neunkirchen, in the Saar, it is impossible at the present moment to give a coherent account of what happened. The accident occurred at six o'clock in the evening of February 10th, and over sixty persons were killed and many hundreds injured. Aerial photographs show that the whole surrounding neighbourhood was laid waste as if a large dump of explosives had been fired. The gas container was of the modern piston or "dry" type, and of exceptionally large size, as it had a capacity of 125,000 cubic metres. It belonged and was adjacent to, the Neunkirchen Ironworks, which were partly wrecked by the force of the explosion, and then ignited. Reports say—we know not with what accuracy—that the spontaneous combustion of brown coal gas in underground pipes near the container caused flames to play upon it, and in a minute or two caused the disaster. That explanation does not account for the violence of the explosion, which implies that the contained gas was mixed with a large quantity of air. Moreover, unless the piston jammed, its weight would have driven the gas out, and it would have burnt, without explosion, as in other recorded failures of gas holders, for example, at Hamburg and Greenwich.

Surplus Tonnage.

THE annual report of the Chamber of Shipping of the United Kingdom, which was presented at the annual meeting on Thursday last, says that in contrast with the decline in world trade, tonnage has increased from 49 million gross tons before the war to 70 million gross tons, or by 43 per cent., whilst world ocean-going tonnage (steam and motor ships of 2000 tons gross and upwards) has risen from 33 million gross tons to 52 million gross tons, an increase of 58 per cent. Moreover, ships move more quickly than before the war, and the quantity of cargo carried per ton has increased. The result is that 14¼ million tons, or 21½ per cent., of world shipping is laid up. This great disparity between the volume of trade and shipping has, in the opinion of the Chamber, largely been created by the action of Governments in building and running ships for political and not commercial reasons. Until such uneconomic interferences are abandoned they will continue to depress the freight market, disorganise the industry, and make assisted and unassisted vessels alike unprofitable. A committee of leading shipowners reported to the International Chamber of Commerce that so long as artificial assistance continued, measures of rationalisation to adjust supply to demand would be useless. The Chamber has, however, examined the possibility of rationalisation, and notes that while British shipowners have accepted rationalisation in principle, it has hitherto not been found practicable to devise a scheme which would meet with general acceptance. In the meantime, internal rationalisation by liner conferences has continued, and automatic rationalisation by the laying up of tramps.

Manufacturers and the Railways.

SOME time ago the Ministry of Transport asked the National Union of Manufacturers for its views on rail transport, and the Union has now sent to the Minister a memorandum on the question. It is recommended therein that statutory restrictions with regard to charges imposed on the railways should be relaxed. The memorandum calls attention to the fact that under the Railways Act of 1921 railway charges are based upon the revenue of one particular year, 1913. That is considered a fundamentally unsound basis on which to arrange a system of charges for any undertaking, particularly when that undertaking is expected to pay its way under present conditions. The memorandum suggests that the desirability of abandoning such a principle should be considered. Arguing that the whole of the Act of 1921 is based on the supposition that the railways had a monopoly, and thus needed to be regulated, the memorandum points out that the course of events since that year has shown the monopoly to be non-existent. It is therefore the opinion of the Union that the whole basis of the Act is in need of reconsideration, and that a comprehensive review of railway legislation will have to be made sooner or later. When that review is undertaken the railways should be given as great a measure of freedom as that enjoyed by competitors.

Turbo-Electric Liner Queen of Bermuda.

EARLY in the week the 20,000-ton electrically propelled liner "Queen of Bermuda" carried out successful trials on the Skelmorlie measured mile and in the Forth of Clyde. As recorded in our issue of January 6th, the new liner has been specially built by Vickers-Armstrongs at Barrow, for the New York-Bermuda service of Furness, Withy and Co., Ltd. Her propelling machinery consists of a pair of 7500-kW Fraser and Chalmers-G.E.C. turbo-alternators, running at 3000 r.p.m. and supplying current to four 4750 S.H.P., 250 r.p.m. motors, each coupled to a propeller shaft. There are four 750-kW auxiliary generator sets and steam is supplied by high-pressure Babcock and Wilcox water-tube boilers burning oil fuel under closed stokehold conditions. The liner left the builders' yard at the end of last week and was dry-docked at Cammell Laird's Birkenhead yard, where her two outer propellers were fitted. She sailed from the Mersey shortly after mid-day on Monday last, February 13th, and, after compass-adjusting trials, proceeded to the Firth of Clyde, where the progressive measured mile trials and the steering trials were carried out. The average speed attained was 20·7 knots and the maximum speed recorded was 21·07 knots. A large number of guests were invited to attend the trials by Vickers-Armstrongs, Ltd., and were received by Commander C. W. Craven. The weather conditions were ideal, and a very enjoyable time was spent.

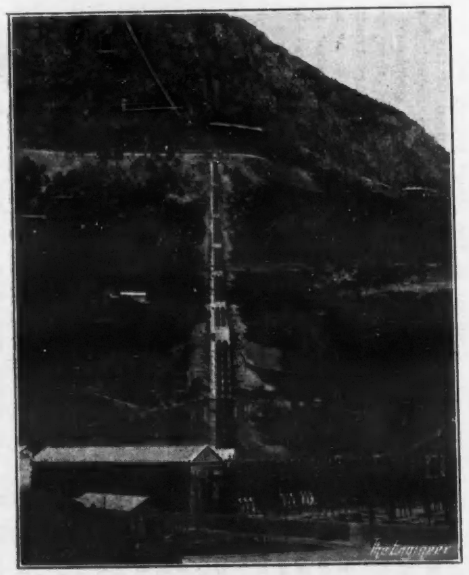
Shipbuilding and Labour Conference.

ON Wednesday of last week, February 8th, an important conference took place at Edinburgh between representatives of the Shipbuilding Employers' Federation, National Shipbuilders' Security, Ltd., and the shipyard trade unions. Mr. J. B. Hutchison, the President of the Shipbuilding Employers' Federation, acted as chairman of the employers' side; Sir James Lithgow represented National Shipbuilders' Security, Ltd.; and Mr. Will Sherwood, of the General Workers' Union and President of the Shipbuilding and Engineering Trade Federation, was chairman of the trade union side. The questions discussed included the principle of giving consideration to displaced workmen once employed in the redundant shipyards, now closed, and the creation of subsidiary trades and ancillary industries. Sir James Lithgow argued for National Shipbuilders' Security, Ltd., that there would not be any displacement of labour, and that the improved efficiency of the industry resulting from concentration would enable more work to be obtained as trade improved. As regards new industries, efforts, he said, had been made to encourage local or new industries to begin operations on the shipyard sites vacated. The creation of special industries ancillary to the shipbuilding industry would receive very serious consideration, but he did not hold out much hope of progress being made in that direction. The conference thereafter dealt with questions of policy arising from the present world depression, and their effects on British shipping and shipbuilding. The problem of subsidised foreign shipping was also discussed, and attention was again given to the possibility of scrapping obsolete tonnage, which the conference agreed should be considered further by both parties.

RIO CINCA POWER DEVELOPMENT, HUESCA, SPAIN

BOVING AND CO., LTD., LONDON, HYDRAULIC ENGINEERS

(For description see opposite page.)



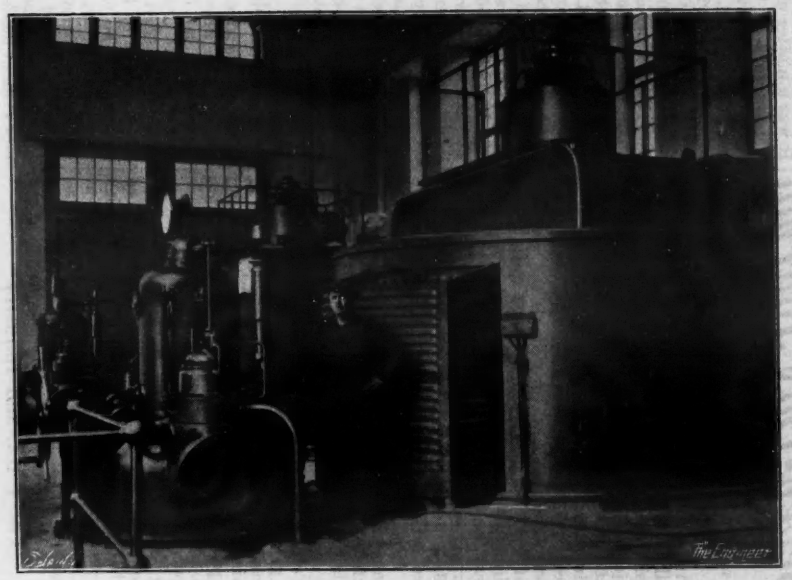
This View and that on the right show the double Pipe Line for the Rio Cinqueta Development.

The Power-House is situated on the left bank of the Rio Cinca, which is seen in the foreground. Water is also drawn from the Rio Cinqueta, which flows down the valley on the right.

This View of the Cinqueta Pipe Line from above also shows the three pipes of the Cinca Line crossing the River.

This Interior View of the Power-House shows the two Cinqueta Turbines in the foreground and the three Cinca Turbines behind.

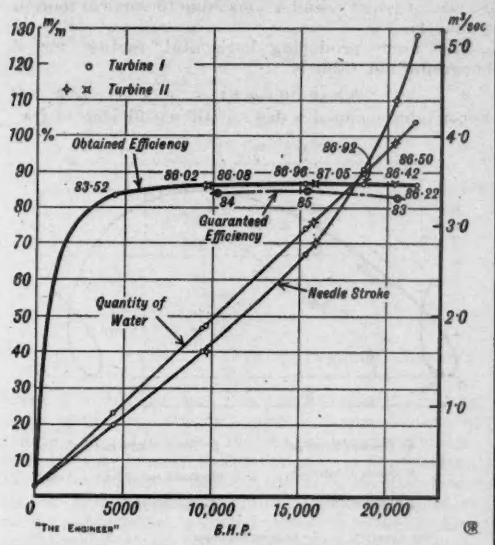
View of the Power-House and Cinqueta Pipe Line.



The Cinqueta Turbine here shown develops 30,000 B.H.P. at 428 r.p.m. and operates with a head of 345 metres.

The Rio Cinca Power Plant.

As a technical newspaper it is not often that we have the opportunity to reproduce photographs of terrain so remarkable as that illustrated by an engraving on page 160. This panorama shows the site in the province of Huesca, on the southern side of the Pyrenees, of the largest water power development in Spain. The river in the foreground is the Rio Cinca, on the left bank of which the main power-house stands. The water is drawn both from the upper reaches of that river and from the Rio Cinquetta, a tributary which flows down the valley to be seen on the right of the picture. Two engravings flanking the panorama show the double pipe line of the Rio Cinqueta development leading the water from a canal on the mountain side to the power-house, while in the general view the pipe line of the Rio Cinca development bringing down the waters from



TEST RESULTS OF CINCA TURBINES

a reservoir on the mountain on the right bank is just discernible. This pipe line is taken across the waters of the river to the power station. The total output of the plant now that the last two units have been started up is 120,000 B.H.P., and it is owned by La Sociedad Anonima Hidroelectrica Iberica, of Bilbao. All five units were supplied by Boving and Co., Ltd., of London, and the main portions of each of the turbines were built in Sweden at the works, "Verkstaden," Kristinehamn. The steel distribution pipes for two units and the inlet valves for three were manufactured in England, while the pit linings for all five were supplied by the Babcock and Wilcox works at Bilbao.

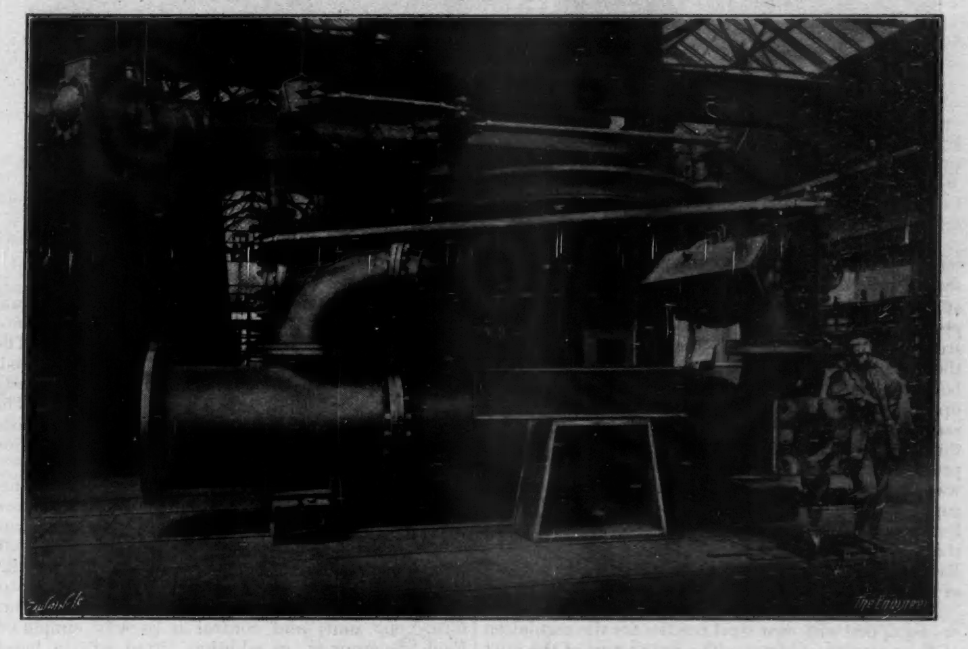
Three of the turbines are fed by the waters from the Rio Cinca itself. One of the turbines erected in the makers' works is shown in a tone engraving. They are designed for 20,500 B.H.P. each at 450 m. (1480ft.) net head, but give a maximum output of 21,700 B.H.P., as is shown by the test curves reproduced on this page. The additional two turbines which have been installed in the same power-house are fed from Rio Cinqueta, and therefore receive their supply from inlet pipes coming in from the opposite side. They are designed for 30,000 B.H.P. each at 345 m. (1135ft.) net head.

The Rio Cinca Fall was first brought into use. The first two turbines for it were ordered in 1920 and supplied in 1921. They are vertical shaft Pelton wheels, with a guaranteed output of 20,500 B.H.P. each and run at 500 r.p.m. Almost a year after being put into regular service they were tested for efficiency by a commission representing the customer and the suppliers. The efficiencies obtained, as well as those guaranteed, will be seen from the test curves. The speed of the water was measured on two diameters—at right angles to each other—by means of a current meter set in different positions in the pipe, and the head was calculated in the usual manner as the manometric head at the sluice valve referred to runner's centre plus the velocity head at the section of measurement. The power was absorbed by means of an ample water resistance specially built for this purpose and was measured by the 2 wattmeter method. All the electric precision instruments used for the test were calibrated at official laboratories in Madrid, and the stop watches used when measuring the water were calibrated at the Astronomical Observatory of Madrid.

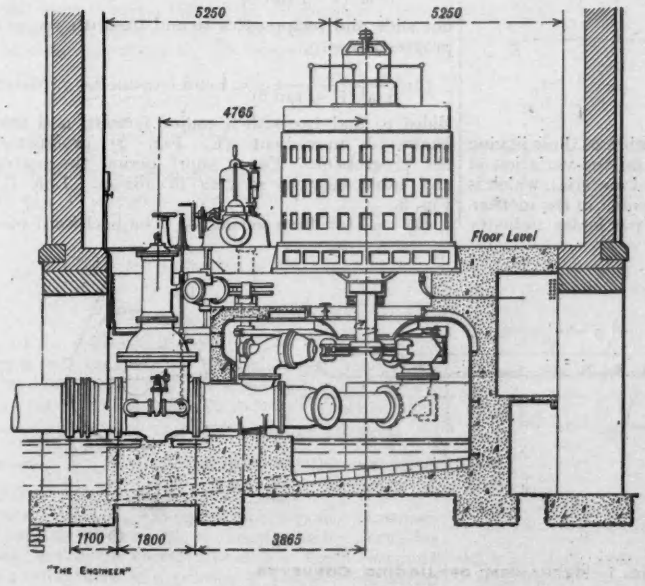
A third turbine was ordered in 1924 for the same output and characteristics as the two turbines already installed. This machine is specially arranged to operate from either the Cinca River or the Cinqueta River. For this reason it has two inlets, one at each side of the building, and the two inlet valves are built to resist full water pressure from either side. When operating from the Cinca supply this turbine gives the same output as the first two Rio Cinca machines, or 20,500 B.H.P. at 500 r.p.m. When operating from the Cinqueta side its output is approximately 14,500 B.H.P. at 500 r.p.m., the reduction being due to the much lower head and also to the slightly reduced efficiency when working under this head and running at unaltered speed.

DOUBLE BUCKET OF CINCA TURBINE

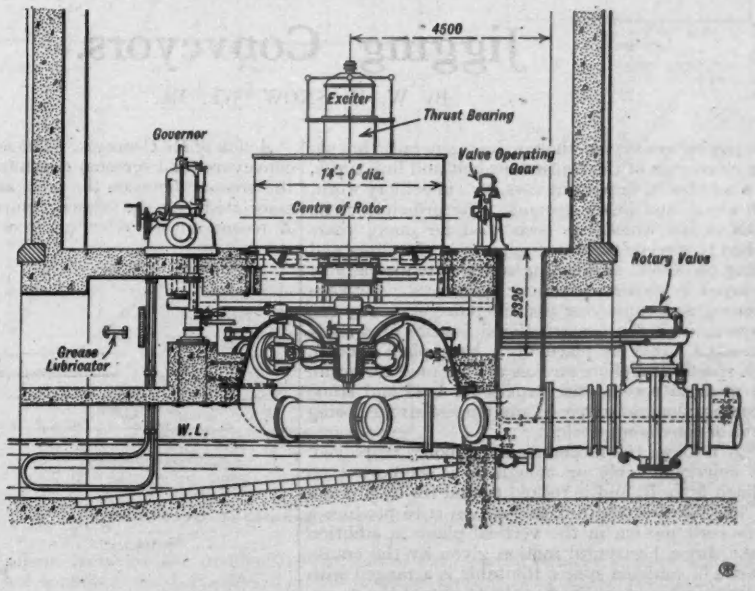
Each of the three Rio Cinca turbines has three jets fed from a distribution pipe system under the turbine. The units are all of the vertical shaft type and have their runners mounted overhung on the free end of the generator shaft. The turbines have no bearings of their own, so that for each complete generating set of turbine and generator there are only two guide bearings, besides the thrust bearing, which is combined with the upper guide bearing.



ONE OF THE TURBINES FOR THE RIO CINCA DEVELOPMENT



RIO CINCA TURBINE ARRANGEMENT



RIO CINQUETA TURBINE ARRANGEMENT

The two turbines for the Rio Cinqueta development were ordered in 1929 and supplied in 1930. They were recently erected and are now both in service. A photograph reproduced on this page shows these two turbines under construction. One has been in operation since the end of 1931 and the second since August, 1932. They are designed to work under the available net head, 345 m., and each has a guaranteed output of 30,000 B.H.P. at a normal speed of 428 r.p.m. These turbines are practically of the same design as the Cinca turbines, but some features are different. The Cinqueta turbines have four jets each and the casing round the turbine is of a more compact design, permitting easier inspection of regulating parts. Views of the interior of the power-house, showing both types of turbine, are to be seen on page 160, while sectional drawings accompany this article.

The buckets for all the five turbines are of the double type, as illustrated. The inner surfaces

RIO CINQUETA TURBINES UNDER CONSTRUCTION

of each bucket were ground very carefully to template by means of grinding machines specially constructed for the purpose. Each bucket is fixed to the runner disc by means of three bolts. These bolts are so dimensioned that they are able to take up all the stresses alone, and keying of any sort is rendered unnecessary. The buckets for the Rio Cinca turbines were made of best cast steel, and have proved to be very satisfactory. When the third unit was supplied the power company agreed to the suppliers conducting experiments in the use of stainless steel, and a few of the buckets were made of this material, which has proved to be superior. The Rio Cinqueta turbines are built with all the buckets of stainless steel.

All the inlet bends are made of cast steel and are equipped with cast steel needles for the regulation of the quantity of water. The nozzle tips of the inlet bends and the needle tips are made easily renewable. For the Rio Cinqueta machines, however, these tips are of special stainless steel, which reduces the possibility of wear.

The regulation of all the turbines is effected by means of the needle and deflector system. With this system the first action of the governor on load being reduced, is rapidly to deflect the jets away from the wheel by means of simple deflector plates. The same movement of the governor disconnects the needles and allows them to travel slowly forward under the action of springs in the needle housings, but at a rate determined by the speed of movement of the dashpot incorporated in the needle interconnecting system. The rate of closing of the dashpot can be fixed beforehand at any figure to suit the pressure rise allowed in the pipe line. In order to deflect the whole stream the deflector need only cut about half-way into the jet. As the needle moves forward, the diameter of the jet diminishes steadily until the movement is complete and the jet is reduced to the desired extent, when the deflector is again just clear of the reduced jet and ready to come into operation if the load is still further reduced. The action of the governor, on load being increased, is to open both needle and deflector simultaneously at such a speed as is safe for the pipe line. The various connecting links in the needle mechanism are adjustable to ensure simultaneous operation of both needles and deflectors.

The automatic speed governors for all turbines are of Boving's V.K. type for large vertical turbines. The principal parts of the governor are a highly sensitive evolvent pendulum, a self-contained pumping system with air vessel, operating valves, and compensating gear. The servo-motor is also embodied in the main governor, which thus forms one unit, and control is greatly simplified. Each governor is, in addition, fitted with a hand-controlled operating gear, which can be connected or disconnected by one single movement of a handle.

Jigging Conveyors.

By W. H. SNOW, Wh. Ex.

THE jigging conveyor, though less generally known than conveyors of the continuous belt and link types, has a number of important uses, *e.g.*, in colliery work, both above and below ground. The principle of its action is one which has been used for many years applied to screens for dressing grain in threshing and milling processes, and jigging screens are also largely employed in pithead screening operations. Between screening and conveying the difference is mainly one of speed, with the constructional feature of a short perforated table in place of a long plain trough. High speeds and short strokes are adopted for grain, and medium speeds and strokes for coal and stone screening, the lowest speeds and longest strokes being found in conveying work.

Fig. 1 shows the mechanism commonly employed. The conveyor table or trough A is supported on inclined links B, and is rocked to and fro by a crank C. The effect of the link inclination is to produce a component motion in the vertical plane in addition to the direct horizontal motion given by the crank. For use in confined spaces the table is arranged with rollers running on inclined paths to obtain the necessary vertical motion. The table may be horizontal, or tilted either upwards or downwards in the direction of flow of the material. In the case of wet materials, *e.g.*, washed coal, an upward slope allows the water to drain back, and assists in separating it from the product.

Action of the Conveyor.—The action of these jigging conveyors (and screens) depends on the variation of the pressure between the table and material, which is associated with the vertical component of the motion. A recent author referring to a particular industry has remarked: "It is probably true to say that machines are still being designed on a purely empirical basis with little direct consideration or even understanding of the physical laws which control their working."* The present writer has found a singular diversity of ideas among makers and users of jigging apparatus regarding the precise mode in which the flow of the material takes place, and some explanation in detail may be useful at this point. The locus of a point on the surface of the table is approximately a straight line, inclined θ deg. to the horizontal, coinciding with the arc of swing of the free ends of the supporting links. If r is the crank radius, then the table has an approximate S.H.M.

$\frac{2r}{\cos\theta}$ with component S.H.M. $2r$ and $2r\tan\theta$ in the horizontal and vertical planes respectively. The acceleration vertically is

$$a\cos\varphi = r\omega^2\tan\theta\cos\varphi \quad . \quad . \quad \text{equa. (1)}$$

where ω=angular velocity of crank and φ=crank displacement measured from zero stroke. The pressure of the material on the table thus undergoes a cyclical change as follows:—

Angle φ ..	0	$\frac{\pi}{2}$	π	$\frac{3}{2}\pi$	2π
$\frac{\text{Pressure}}{\text{Mass}}$ ..	$g+a$	g	$g-a$	g	$g+a$

g=acc. of gravity, and a=acc. due to vertical motion (equa. 1).

The force producing horizontal motion for a horizontal flat table is

$$m\mu(g+a\cos\varphi) \quad . \quad . \quad . \quad . \quad \text{equa. (2)}$$

For a table inclined α deg., μ (the coefficient of friction) becomes $\tan(\tan^{-1}\mu\pm\alpha)$. The material is dragged forward with the table during the period when the friction force is high, and it slides on by virtue of its momentum when the force is low. A typical diagram giving the motion of the material in relation to that of the table is given in Fig. 2.

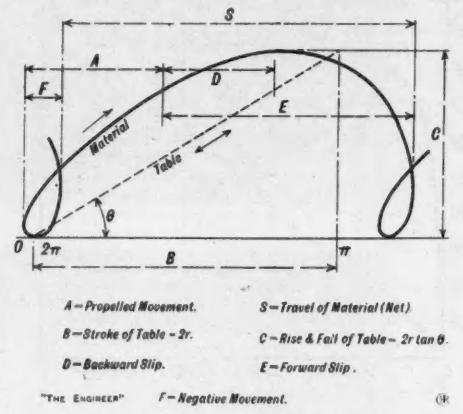


FIG. 2—TYPICAL MOTION DIAGRAM—MATERIAL RELATIVE TO TABLE

If the acceleration in the vertical plane, as given by equation 1, becomes $> g$, the pressure between material and table falls below zero and the material jumps. It is commonly supposed that in this type of apparatus jumping is necessary to the action; but the condition only arises as shown, and is, in fact, inimical to the best results. As will be seen, the motion is complex. It cannot in general be expressed by a simple formula, and available data relates almost entirely to experimental results. Analysis shows that the quality of the motion alters as the speed changes, and that there are four principal phases, viz.:—

(1) $\frac{\mu g}{r\omega^2(1-\mu\tan\theta)} = \text{or} > 1$. The material will not slide and reciprocates to and fro with the table-progression zero.

(2) $\frac{\mu g}{r\omega^2(1-\mu\tan\theta)} < 1$ and $r\omega^2\tan\theta < g$. Material slides to and fro with a major forward and minor backward movement (E, Fig. 2) producing a net progression. For a short period the material and table may be moving in unison. Line C_1C_2, Fig. 3.

(3) $r\omega^2\tan\theta = g$ (equa. 3). The backward movement becomes zero and progression is a maximum. Line B, Fig. 3.

(4) $r\omega^2\tan\theta > g$. Jumping occurs as already explained. There is a recurrence of back movement and the progression falls off in greater ratio than the speed increases. The periodic movement takes place

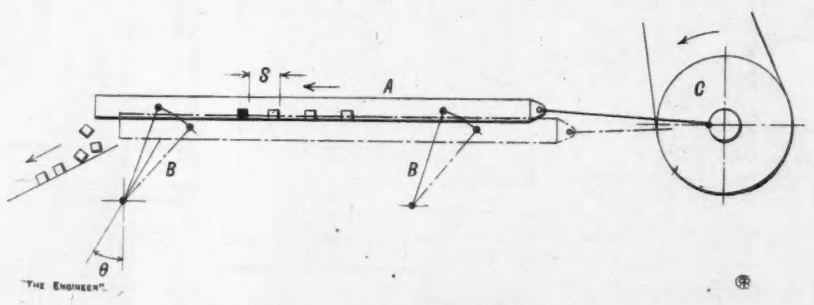


FIG. 1—MECHANISM OF JIGGING CONVEYOR

* "Engineering of Flour Milling," by Sir E. D. Simon.

with varying amplitude, and passes through cyclical changes from max. to min., or the movement may become erratic.

With μ and tan θ constant, the phases occur in the order of increase of the product $r\,\omega$=crank velocity; or if r is constant they follow increase of speed (revs.).

The law of motion is V=force per unit mass × time.

$$V=\mu\,(k\,g+r\,\omega^2\tan\theta\,\psi\cos\varphi)\,\frac{\varphi}{\omega} \quad . \quad . \quad \text{equa. (4)}$$

In general the motion is too complex for easy mathematical treatment, but the limiting case (3) can be dealt with very simply; and it happens that in practice only this phase, the one producing maximum flow, has any interest in the majority of applications. Where regulation of flow by means of variable crank radius or speed variation is in question, as in some recent applications, a graphic solution is the readiest and obtainable with only a moderate amount of work.

Solution for Phase (3).—Plotting (Fig. 3) a velocity curve V for the conveyor from $v=r\,\omega\sin\varphi$ (equa. 5), and acceleration curves A for the material from equa 1, then if v'=velocity of material,

$$v'=\frac{\mu\,g}{\omega}\int(1+\cos\varphi)\,d\,\varphi=\frac{\mu\,g}{\omega}\,(\varphi+\sin\varphi)+k, \text{ equa. (6)}$$

Let the commencing velocity be 0 when $\varphi=0$, then $k=0$. Substituting in equations (3) and (5) and equating, $\mu\tan\theta=\dfrac{\sin\varphi}{\varphi+\sin\varphi}$, from which φ is > 140 deg. for $\theta=30$ deg., $\mu<0{\cdot}4$. (In most cases μ will not exceed 0·4.) Beyond 140 deg. and up to 220 deg. the acceleration being very small, can be neglected without serious error, and it is sufficiently near to put $v'=\dfrac{\mu\,g}{\omega}\displaystyle\int_0^{\pi}(1+\cos\varphi)\,d\,\varphi$.

At 140 deg. the acceleration (horizontally) becomes negative, the velocity of the table falling below that of the material. As the acceleration from π to $2\,\pi$ is, numerically, the same as from 0 to π, the velocity will change from v' to 0 in the time previously taken to change from 0 to v', the crank displacement being $2\,\pi-\pi$ and the velocity 0 at $\varphi=0$ or $2\,\pi$.

The distance moved by the material in one cycle, *i.e.*, from 0 to $2\,\pi$=s ft.$=\dfrac{2}{\omega}\displaystyle\int_0^{\pi}(\varphi+\sin\varphi)\,d\,\varphi\,\frac{\mu\,g}{\omega}$.

$$=\frac{2\,\mu\,g}{\omega^2}\left(\frac{\pi^2}{2}-\cos\pi+1\right)=\frac{14\,\mu\,g}{\omega^2} \quad . \quad \text{equa. (7)}$$

The flow in feet per minute =V

$$=\frac{14\,\mu\,g}{\omega^2}\times n=\frac{41000\,\mu}{n}=\frac{4300\,\mu}{\omega_1} \quad . \quad . \quad . \quad \text{equa. (8)}$$

$$n=\text{revs. per min.}=54\sqrt{\frac{1}{r\tan\theta}}$$

$$\omega_1=5{\cdot}7\sqrt{\frac{1}{r\tan\theta}} \quad . \quad . \quad \text{from equa. (3)}$$

Thus at the critical speed giving max. flow, the result depends only on friction. The friction in a conveyor can be increased to improve the capacity by using a "vee" or curved section in place of a flat trough. If β=angle of vee, the R.H. side of equation (8) becomes $\dfrac{4300\,\mu}{\omega_1\sin\beta/2}$. A complete tubular section is sometimes adopted for hot materials.

General Solution.—The general solution, a tentative one, consists in obtaining a closed velocity curve for the material in the correct phase, covering a complete cycle; and there is a particular phase relationship between the motions of crank and material for every combination of μ, r, ω and tan θ. (In the special case (3) already dealt with, inspection shows that the two movements are very nearly in phase, or rather multiple phase, thus fixing the limits for the integral expressions and permitting a simple solution. Complete phase equality cannot occur.) The curve is plotted by a step-by-step process, the easiest way being to obtain the integrals by measurement of successive areas, to scale, bounded by the acceleration curve and the base line. Examples are given in Fig. 3. If desired, account can be taken of the different values of the coefficient of friction of motion and from rest, a refinement, however, of doubtful utility when the character of a physical constant such as μ is considered. The point is of minor importance, for as phase (3) is approached there is no coincident movement of table and material, *i.e.*, the material is never relatively at rest, and practical interest is as a rule confined to this.

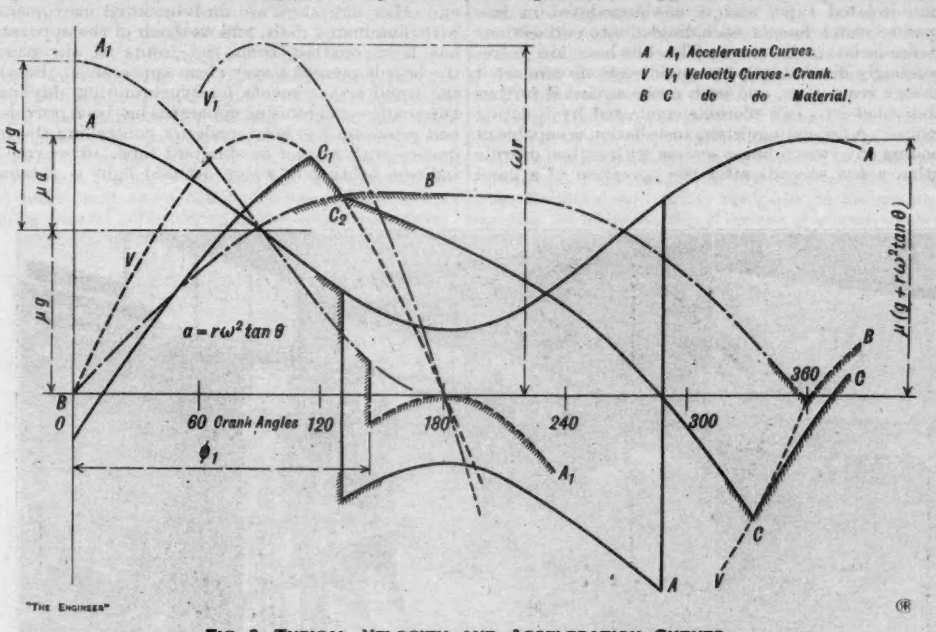


FIG. 3—TYPICAL VELOCITY AND ACCELERATION CURVES

Dynamic Similarity.—Expressing the velocities of material and table as a ratio:

$$\frac{V}{60\,\omega\,r}=\left[\frac{\mu}{r\,\omega^2}\,k\,g+\mu\tan\theta\,\psi\cos\varphi\right]\varphi \quad . \quad \text{equa. (9)}$$

φ is the periodic angle=$2\,\pi$, k a constant, and ψ a function. K and ψ depend on the angular displacement when table and material have the same instantaneous velocity. A small series of curves over the whole range of values of the non-dimensional groups $\dfrac{\mu\,g}{r\,\omega^2}$ and μ tan θ, within the limiting condition of equa. (3) provides sufficient data for solving any case, although four independent variables are involved.

When μ and tan θ are constant, the L.H. side of equation (9) shows that V varies directly as $\sqrt{r}$, or inversely as ω, if the product $r\,\omega^2$ be kept constant. This is the rationale for the low rotational speeds and long cranks adopted for conveying as already mentioned. For screening work, V usually has to take second place, high speed (revs.) being necessary to agitate the material to effect separation. It will be noticed that when dealing with the balancing of the reciprocating parts, the problem—involving $r\,\omega^2$—is a diminishing one for a given flow with increase in r.

Relation Between Variables.—A typical velocity curve for the general case (phase 2) is shown in Fig. 3, curve C. From a number of such curves—ω variable, r, μ and tan θ constant—a series of relations of V and ω is obtained. Repeating the work for other values of the "μ" constant, several characteristic curves, Fig. 4, are obtained. Finally, by diversity of combination of the variables in the two groups of the R.H. side of equation (9) for each group value over the range previously covered, V is obtained in relation to r, μ, or tan θ, Figs. 5, 6 and 7. Examples are given below.

	μ.	r.	n.	tan θ.	$\mu/r\,\omega^2$.	μ tan θ.	V/$r\,\omega$.	V.
From curve	0·3	1in.	240	0·580	0·0068	0·174	25	48
Derived ..	0·3	½in.	340	,,	,,	,,	,,	34
,, ..	0·4	¼in.	390	0·435	,,	,,	,,	39
From curve	0·15	1in.	150	0·580	0·0087	0·087	9	16
Derived ..	0·3	½in.	300	0·290	,,	,,	,,	16
,, ..	0·3	¼in.	107	,,	,,	,,	,,	45

The characteristic curves Fig. 4 have the form $y=a\,x^n$, ordinates y and x referring to a pair of co-ordinates passing near the point $V=\dfrac{4300\,\mu}{\omega_1}$, ω_1 being the critical speed. As the output changes only slowly in the neighbourhood of ω_1—particularly with low values of μ—a constant output machine should be run somewhat below the optimum speed so as to ease the problem of balancing the reciprocating load. The equation to the curve for constant output machines (representing the majority of cases) is of little practical importance. Where control of flow by variation of crank shaft speed, or crank radius, is in question, as in some conveying operations, the limit of the effective range of values of $r\,\omega^2$ is definitely below the optimum value, and only the steeper and straighter parts of the curve need be considered. A simple straight line equation, V=A−B N (revs.), can then be used which is good enough for practical purposes. For example, line E E, Fig. 6, covers a range of flow of 4/1, with a speed change of 5/3, with a deviation of less than 10 per cent. from the original curve.

Power.—The movement of the material relative to the table involves a friction loss. Under optimum conditions of flow this can be shown to be equal to twice the energy acquired by the material per stroke, and given by $m\,v_1^2=2\,m\left[\left(\dfrac{\mu\,g}{\omega}\right)^2\dfrac{\pi^2}{2}\right]$. Putting

L=length of table,

H.P. per ton delivered per min.=$0{\cdot}05\,\mu\,L$ . . (10)

The numerical coefficient in this and other expressions will generally require modification to take account of motion of the material relative to itself additional to the principal simple sliding motion postulated. The calculated results will, again, be affected by the massing of the material, rate of feed, and interference between different pieces, necessitating the introduction in some cases of a simple experimental factor or the use of an artificial value of μ. The formula neglects the power absorbed in the mechanism.

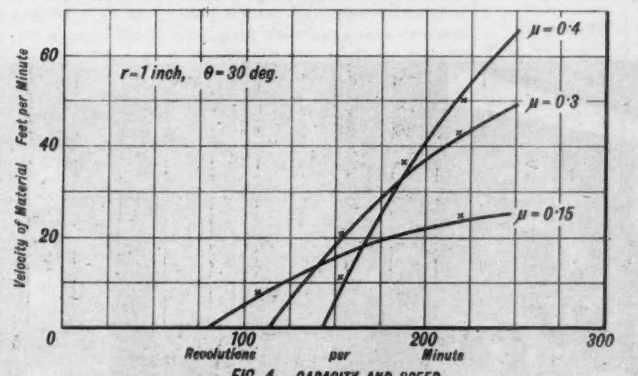


FIG. 4. CAPACITY AND SPEED.

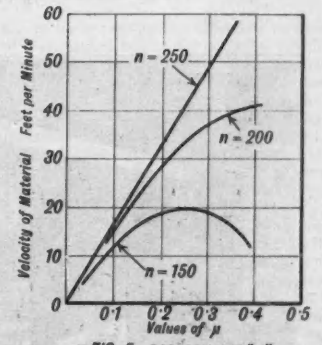


FIG. 5. CAPACITY AND "μ".

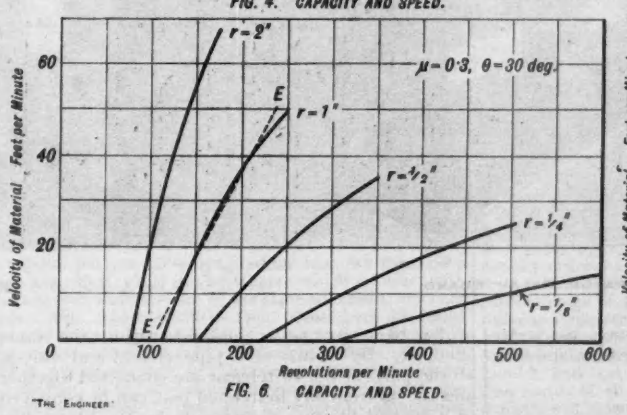


FIG. 6 CAPACITY AND SPEED.

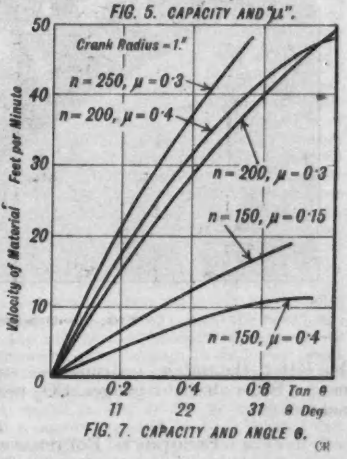


FIG. 7. CAPACITY AND ANGLE θ.

FIGS. 4 TO 7—CHARACTERISTIC CURVES

The New Dunston Power Station.

No. II.

(*Concluded from page* 139, *February* 10*th*.)

FOR each turbo-alternator and its condensing plant there is a resistance type distance thermometer, for indicating various temperatures, such as those of the steam, condensate, circulating water, and oil. A resistance type recording thermometer records the temperatures of the steam supplied to the high and low-pressure turbine cylinders, whilst an indicating, recording and integrating water meter measures the quantity of condensate leaving the condensers. The instruments associated with each boiler and reheater unit consist of an indicating multiple-point draught gauge for measuring the pressures and suctions at various points of the units, an indicating and recording CO_2 meter for measuring the percentage of CO_2 at various points, and a Venturi integrating and indicating feed-water flow meter for measuring the quantity of feed water. To ensure the correct ratio of air supply and steam output of each pulverised fuel fired boiler and reheater unit, there is a steam flow/air flow ratio meter. The main instruments for the turbine-room and boiler-houses were supplied by the Cambridge Instrument Company, and the Electroflo Meter Company, the former firm supplying the electrical thermometers and pyrometers, and the latter the other instruments, such as water meters, boiler draught gauges, CO_2 meters, and flow meters.

ELECTRICAL EQUIPMENT.

Each of the turbo-alternator sets generates at a pressure of 13,500 volts, which is raised to 66,000 volts by means of three 63,000 kVA Ferranti outdoor oil-immersed, forced-cooled Ferranti transformers (Fig. 17), with water circulation. There are two oil coolers mounted together with each transformer, which may be operated at reduced output with one cooler in use. Ferranti, Ltd., also supplied two 7500-kVA outdoor auxiliary transformers with a ratio of 66,000/3000 volts. The main 66,000-volt Reyrolle switchgear shown in Fig. 12 in our last issue is of the duplicate bus-bar, metal-clad, oil-filled, phase-isolated type, and is accommodated in two separate switch-houses, each divided into two sections by fire-isolating barriers. The bus-bars are correspondingly divided into two main sections connected through reactances, and each main section is further subdivided into two sections connected by isolating devices. A fire-extinguishing installation is capable of flooding any switch-house section with carbon dioxide within a few seconds after the operation of a hand lever outside the building. Arrangements have also been made to allow oil from a burst tank to be drained away as quickly as possible.

FIG. 13—CONTROL ROOM

FIG. 14—AUXILIARY SWITCHGEAR

MAIN CIRCUIT BREAKERS.

The electrically operated remote controlled multi-break circuit breakers have a rupturing capacity of 1,500,000 kVA. Isolation, bus-bar selection, &c., are carried out manually by a system of levers which are interlocked to prevent incorrect operation. For this class of gear the method of bus-bar selection is novel, for oil-immersed isolators give two-point isolation and ensure that connections from both sets of bus-bars are never brought within the same chamber. By means of a pipe system and valves, all the parts of the switchgear are connected together and the oil from any individual part can be conveyed to a central filtering plant made by the Streamline Filter Company. Each oil chamber is also permanently connected to a conservator which ensures that the chamber is always full, and allows for expansion and contraction of the oil. The neutral point of the 66,000-volt system is earthed through Reyrolle liquid earthing resistances, as shown in Fig. 18.

CONTROL-ROOM.

With a view to rendering the operation and maintenance of the control apparatus as simple as possible, special attention was paid to the design of the Reyrolle control-room, shown in Fig. 13. Only apparatus that is necessary for actual operation is accommodated on the control panels, relays, test terminals, &c., being placed on a second row of panels behind the control panels. The generator relay board is shown in Fig. 15, and the metering panels in Fig. 16. Over each control panel there is a miniature diagram panel, on which the open and closed positions of the circuit breakers, isolators, &c., controlled from the panel are indicated by automatic semaphores. All meters and other indicators are flush-mounted instruments, with illuminated dials, and as much of the apparatus has been omitted from the fronts of the panels the boards present a very clean appearance. Besides the usual arrangements for synchronising, duplicate automatic synchronising apparatus has been provided, and provision has been made for controlling the frequency with respect to standard time. A scheme of indirect lighting in which diffused light is obtained from batteries of concealed lamps is another special feature of the operating-room.

AUXILIARY SWITCHGEAR.

The auxiliary motors associated with a turbo-alternator set and its corresponding bank of boilers are normally supplied from a "unit" auxiliary switchboard, fed from a unit auxiliary transformer supplied from the terminals of the particular machine. There is also a station auxiliary switchboard from which the starting up supply to any unit auxiliary switchboard is given, and from which, generally speaking, all auxiliary supplies common to the whole station are given. Normally, the station auxiliary switchboard is fed from the main 66,000-volt switchboard, through two station transformers, but it may also be fed from the house set illustrated in Fig. 11 in our last issue. The unit and station switchboards are arranged along a gallery between the turbine floor and the basement on the south side of the turbine-house, and they are controlled electrically from panels immediately above them on the turbine floor. From the unit and station switchboards which all operate at 3000 volts, feeders are taken to local distribution points at a central position relative to a group of motors, and at these points group auxiliary transformers supplied by C. A. Parsons and Co., reduce the pressure to 400 volts for distribution to the several motors of

FIG. 15—GENERATOR RELAY BOARD

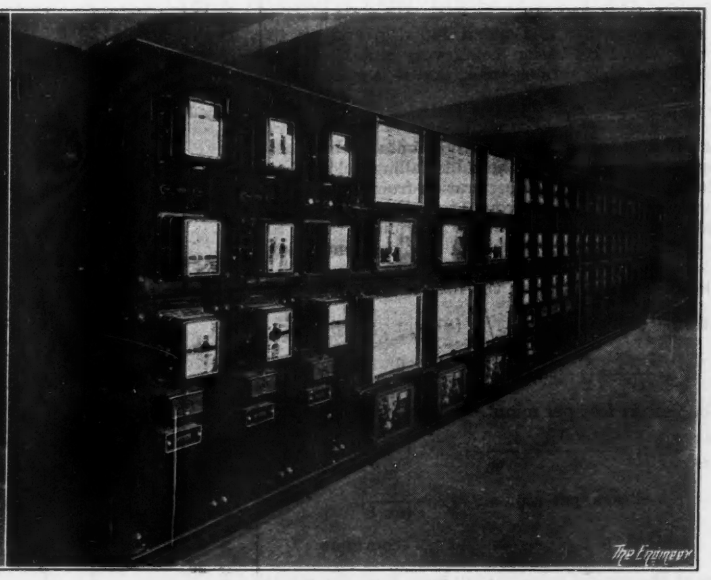


FIG. 16—METERING PANELS

a group, a scheme which simplifies the cabling and reduces the rupturing duty of the switchgear in the individual motor circuits. A view of the 3000-volt and 400-volt auxiliary switchgear, comprising electrically operated metal-clad circuit breakers, and 400-volt cubicles, with Reyrolle cartridge fuses for generator auxiliaries, is given in Fig. 14. All the motors are directly started at full voltage and advantage is taken of this to control the boiler auxiliaries from the gauge boards, by means of electrically operated contactors controlled by push buttons.

CABLES.

All the main and auxiliary cables in the power station were supplied by British Insulated Cables, Ltd., and have been run along definite routes provided during the construction of the foundations and buildings. Cable tunnels divided in a manner corresponding to the sectioning of the switch-house were run between the latter and the turbine-room, across that room, and along the boiler-houses, whilst for running control cables along routes other than those of the tunnels, use has been made of perforated steel trays hung from the underside of floors, &c.

At present there are sixteen outgoing feeders, of which ten, supplied by British Insulated Cables, are owned by the company, whilst the remaining six, supplied by Pirelli General Cable Works, are owned by the Central Electricity Board. The station forms the most important centre of the "Grid" in North-East England. Adjacent to the company's site the Board has constructed a transforming station and three of the outgoing feeders from the station are connected to transformers, which raise the pressure to 132,000 volts and supply two main lines running south to Norton, where there are branches to North Tees, Darlington and York. There is also a line running north to Galashiels, and thence to Edinburgh. The other three connections of the Central Electricity Board feed the Board's 66-kV transmission system to the south of the Tyne, which links up with Sunderland, South Shields, and Carville. The company's own feeders consist of (1) two circuits carried at high level across the Tyne, running northwards to feed into the Northumbrian coalfield; (2) two circuits which run into the centre of Newcastle; (3) two circuits which run southwards to the Durham coalfields, and link up with the North Tees power station; and (4) four circuits which supply a transforming station on the station site, in which the pressure is lowered to 20,000 and 5750 volts for feeding the existing local networks. All the sixteen circuits from the switch-house are composed of underground 66-kV cables, fourteen being of the oil-filled type and two of normal type. In the case of the two feeders to the centre of Newcastle, cable is used for the whole route, but all other outgoing feeders are connected to overhead lines, and those going northwards cross the river Tyne on high towers. The consulting engineers were Merz and McLellan, of London and Newcastle-upon-Tyne.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

OIL-ELECTRIC LOCOMOTIVES.

SIR,—In your valuable leading article, entitled "Oil Locomotives," in the January 20th issue of THE ENGINEER, you draw attention to the importance of the use of the high-speed oil engine with a view not only to obtaining low first cost, but also so as to reduce to a minimum the space occupied by the power plant. The latter is a very important point, which perhaps was given insufficient prominence in my paper. It is clear that the weight of the structure of the locomotive or car supporting and housing the generating set must be added to the weight of the power-producing plant itself.

With regard to my figure of £2 10s. per horse-power for the oil engine, as you state, those who took part in the discussion appeared to be referring to the existing medium-speed engine when giving cost figures of £4 to £5 per ton. If reference is made to Fig. 2 in your reprint of my paper, it will be found that for an engine running at 600 r.p.m. the cost per B.H.P. is given as £4 10s. I submit, therefore, that—seeing everyone was prepared to admit the accuracy of my chart up to 600 r.p.m.—it is hardly reasonable to question my figures at 1500 r.p.m.

As Mr. Thornycroft pointed out in your issue of February 3rd, technical difficulties are not necessarily increased by the use of high rotational speeds, bearing loadings being dependent on piston speed.

I was glad to note in your issue of January 27th that so great an authority as Colonel Ionides confirms my figure of £13 10s. as a reasonable one for first cost of oil-electric locomotives. Doubtless he was referring to a point raised in the discussion, and not to my paper, in his remarks regarding the inadvisability of the use of a large number of small engines for high powers, as this was not, of course, advocated by me.

In reply to Mr. Acland, the B.H.P. figures given in my Table I. are the maximum B.H.P. which, in my opinion, it is necessary to produce from an oil engine applying its power to the rail through electric transmission in order that the oil-electric locomotive may be capable of doing the normal work of the services referred to on a comparable basis with existing steam engines. The maximum horse-power of which a steam locomotive is capable is dependent mainly upon its boiler capacity, and Mr. Acland is therefore quite correct in stating that steam locomotives normally used for slow heavy work are capable of higher horse-powers than those given by me, but these higher horse-powers involve higher running speeds, which are not necessary or even desirable for the particular services concerned.

L. F. R. FELL.

London, W.1, February 14th.

FIG. 17—63,000-kVA TRANSFORMER

FIG. 18—LIQUID EARTHING RESISTANCES

American Engineering News.

An Open Floor Bridge.

THE great extent to which motor traffic has superseded horse-drawn traffic on American streets and roads is illustrated by the recent construction of a bascule bridge with an open floor of steel network, in order to reduce the dead load of the bridge. This bridge is at Seattle, U.S.A., on a thoroughfare where motor traffic is so dense as practically to exclude horse-drawn vehicles. Sheep, hogs, and cattle are not driven on the road, but are carried in motor trucks. The floor framing consists of 15in. rolled steel joists as longitudinals, across which are laid 6in. rolled channels spaced 15in. apart. Upon these channels are laid the sheets of steel mesh, which consists of longitudinal bars, on edge, 2¼in. apart, having riveted between them bars which are so bent as to form an irregular octagonal pattern. The longitudinal bars are 2¼in. deep and ⅛in. thick, while the bent bars—which are level with the top of the others—are of the same thickness, but only 1¼in. deep. The continuous longitudinal bars are relied upon to prevent lateral skidding of the wheels. Including the steel transverse channels the weight of flooring is only 21½ lb. per square foot, and the open construction permits a reduction in the allowance for wind load, while it also permits a reduction in dead load allowance by eliminating the necessity of providing for snow and ice loads on the floor. Welding is another feature of the construction, as the steel channels are welded to the 15in. longitudinals, and the ready-made panels of steel mesh are field welded to the channels. This is probably the first use of an open-floor deck for a highway bridge, and its use was rendered practicable in this case since horse-drawn vehicles can use other bridges which have the usual solid floor construction.

Gilsonite Mining and Production.

A peculiar asphaltic substance found only in Utah, U.S.A., and termed "gilsonite," is a brilliant black bituminous material classed as an asphaltite, together with grahamite and glance pitch. It is brittle and breaks with a conchoidal fracture. The highest grade is used in the manufacture of paint, varnish, printers' ink, and electrical insulation. Medium grades are used for such moulded articles as switch handles, push buttons, and the mouthpieces of telephones, while the poorer grades are used in compositions for the saturation of roofing felt and waterproofing fabric. The material is found in veins, some of which are estimated by geologists to reach a depth of 2000ft. A typical vein is a vertical fissure in sedimentary measures, and ranging in width from a mere crack to as much as 18ft., but frequently from 26in. to 42in. thick. Mining is done in horizontal drifts 6ft. to 10ft. high, and the full width of the vein; these drifts extending from shafts 250ft. to 500ft. deep. In places, the gilsonite is within 10ft. of the surface, but for 10ft. or 12ft. deep it is so weathered as to be of little use or value. After the drift has extended about 100ft. or 150ft. from the shaft the men work back towards the shaft, excavating the floor to a depth of about a foot. They continue in this way, working to and fro along the drift. As the value of the product depends upon its purity, care is taken to keep out all particles of rock. Blasting is not necessary and would damage the material by shattering. Besides this the gilsonite is highly inflammable, and as the result of serious explosions and fires some mines use only electric lights and cap lamps. The shafts are 200ft. to 300ft. apart.

SIXTY YEARS AGO.

THE year 1872, as we have previously recorded in this note, was a period of unbounded industrial activity in this country and also a period of rapidly rising costs of raw materials. A specific example may be quoted from our issue of February 14th, 1873. During the preceding year, we reported, Messrs. Marshall and Wylie, of the Glasgow Tube Works, had received orders for more than 300,000ft. of boiler tubes. This large volume of business, stated to be, in all probability, unprecedented in the trade, had been secured in spite of the fact that prices were about 110 per cent. higher than they had been fifteen months previously. No one, it seems, was bold enough to suggest that the volume of business being transacted was directly a result of the high cost of raw materials. Instead, the explanation of the great demand was sought for in other directions and the cost of raw materials was regarded with dismay and as foreboding dire trouble. Coal, as usual, was at the bottom of it. The situation, as we sketched it, in a leading article entitled "The Coal Famine," in the issue named above, contained elements of a nature held to be disquieting, even alarming. Mr. Gladstone had refused to institute a parliamentary inquiry into the state of the British coal trade on the ground that it could do no good. Nevertheless we urged that the enlightenment of public opinion on the subject demanded the publication of authoritative information. The plain fact was that within less than two years the cost of coal all over Great Britain had more than doubled. No one seemed to know the true explanation of the rise, but there were uneasy suspicions in existence. Unseen combinations designed for the extortion of the public were freely mentioned. The coal-owners shunned explanations and, confining themselves to generalities, threw the blame on the miners, their strikes, high pay, short time or idleness. The miners were equally reticent. Between the two the public was coming to the belief that the owners, having to face the errors and shortcomings of the miners, had discovered a means of utilising these errors and shortcomings to their own profit in their dealings with the public. The dealers, too, seemed to have joined the conspiracy, for within a week coal in London had been raised to 45s. or 52s. or by 8s. a ton. The motto of all concerned seemed to be "What I can extort I will have and enjoy, let who or what will suffer in consequence." We took a gloomy view of the situation. Permanent injury might be done to our national position and prosperity if the price of coal were not speedily lowered. If the spirit of the times was allowed to prevail, then society in its true sense would be at an end amongst us. We might be rich, adorned with arts and sciences, apparently powerful, but we were on the road to becoming no better than a huge disjointed aggregate of savagery. Something might be done to relieve the situation by importing coal from other countries. That idea pleased us, but we recognised its temerity and reserved our discussion of it for a future occasion.

The British Industries Fair at Birmingham.

No. I.

FOLLOWING our usual practice on these occasions, we include with this issue a Supplement which describes some of the exhibits at the Birmingham Section of the British Industries Fair. That Fair will be the nineteenth, and will, undoubtedly, be larger and more representative than its predecessors. We are glad to say that the Birmingham Chamber of Commerce has seen its way so to finance the undertaking that there will be no fee for admission for those who are seriously interested in the display, and believe that the local industries will benefit thereby. At the same time, there are indications that those visitors with business intentions will not be incommoded by the crowd of sightseers who have sometimes invaded these Fairs.

The Fair, which starts on Monday, February 20th, and continues until March 3rd, will be open from 10 in the morning to 6 o'clock. There will be several ceremonial visits, among which the most important will be that of the Duke of York on the opening day.

Below we give a few more descriptions of the exhibits, and intend to continue them in subsequent issues of THE ENGINEER.

CROMPTON-PARKINSON, LTD.

Motors ranging in size from $^1/_{20}$ H.P. up to large auto-synchronous machines, D.C. motors, generators from $^1/_{20}$ H.P. upwards, portable and switchboard instruments, sheet steel cubicle and other switchgear, and a pole-mounting circuit breaker will be exhibited by Crompton-Parkinson, Ltd., of Bush House, W.C.2. A transformer with on-load tap-changing gear, constructed in accordance with the Crompton-Weaving patents (Fig. 1), is also to be shown. The principle involved was fully described in THE ENGINEER of November 25th, and it is unncessary to deal with the design in detail here. Briefly, the object arrived at is to reduce the induced voltage when the tappings are being changed. The majority of existing systems of changing transformer tappings on load, the makers explain, incorporate selector switches for changing the tappings, and diverter switches for removing the load from the selector switches when the latter are being operated. A somewhat costly and complicated mechanical construction, with cams to ensure proper sequence of operation, is unavoidable with this arrangement. Two other systems, of about the same cost of construction, make use of induction controllers instead of diverter switches, the induction controller being a simple form of induction regulator without moving coils.

Since the voltage difference between tappings is

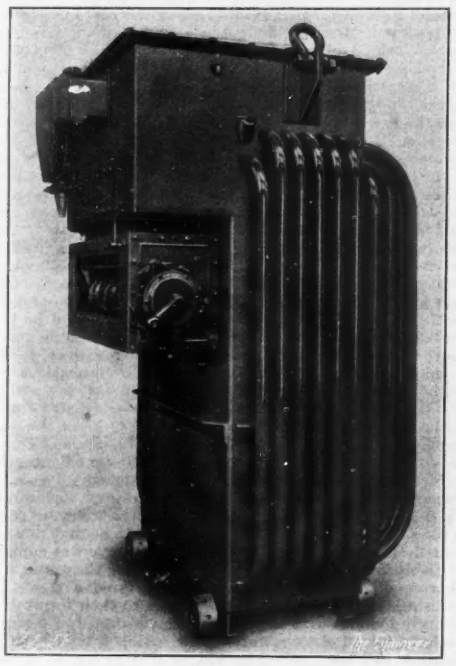


FIG. 1—TRANSFORMER WITH ON-LOAD TAP CHANGING GEAR

comparatively low, a simple switch may appear to be capable of interrupting full load current at this voltage. It is to be remembered, however, that immediately one contact of the selector switch begins to part, the bulk of the current tends to flow through the other half of the winding, and as a result the auto-transformer becomes a choking coil in series with the line, with very heavy flux in the core due to the load current. Since the whole winding is linked up with this flux a voltage is induced which is much greater than the tap voltage, and this tends to maintain an arc across the selector switch contacts. The Crompton-Weaving on-load tap-changing gear overcomes the difficulty by reducing the break voltage, and limits the severity of the duty within the capacity of ordinary selector switches without any mechanical complications. In this new system arcing tendencies are removed by a patented system of transformers, which take the place of the ordinary mid-point balancers.

THE CHESTERFIELD TUBE COMPANY, LTD.

Considerable interest has recently been taken in the question of the use of compressed gas for commercial transport vehicles, and the Chesterfield Tube Company, Ltd., of Chesterfield, has arranged to display a number of special light-weight nickel-chromium-molybdenum alloy steel cylinders which have been designed for the storage of gas at high pressures. These cylinders will include the actual test cylinders which have been used in experimental work carried out by the firm. Larger storage cylinders for the same purpose will be shown at the outside gas compressing stations arranged by Belliss and Morcom, Ltd., and the Bryan Donkin Company, Ltd. A Chesterfield Corporation omnibus which has been converted to run on gas by the Bryan Donkin Company is also to be available for inspection. In addition to the light cylinders referred to, the Chesterfield Tube Company, Ltd., will exhibit weldless steel cylinders for compressed industrial gas, and weldless steel steam pipes and boiler headers. Examples of the firm's new "Feroma" tubes, which are manufactured from the latest types of corrosion and heat-resisting alloy steels, are also to be on view on the stand.

TENSOMETER, LTD.

Two sizes of Hounsfield Tensometers, or multi-purpose, hand-operated, portable testing machines, embracing two 100-ton and one 25-ton machines, arranged for different tests, will be exhibited on the stand of Tensometer Ltd., of 73, Southampton-row, London, W.C.1. The tensometer was invented and designed by Mr. L. H. Hounsfield, and his attachments enable the yield point, maximum stress, and breaking strengths to be graphically recorded, and the elongation per cent. and the reduction of area per cent. to be determined without calculation. The Brinell hardness is also determined by one measurement, and reference to a table, as usual. With brittle materials, such as cast iron, bending tests are usually more reliable than tensile tests, and the span and diameter of the tensometer cast iron test bar have been so determined by experiment that it breaks when the mercury column shows the stress that would be given by a tensile test, so that no further calculation is required. In an article which was published in THE ENGINEER of October 9th, 1931, we described in detail the manner in which the tensile test is carried out. The test piece, which usually has a cross-sectional area of $^1/_{50}$in., is gripped in two pairs of half chucks, and the load is applied by turning a handle which acts through a nut and screw upon the end of a lever and stresses the test piece. The load for the other end of the test piece comes on to the centre of a steel beam, which is slightly deflected by it. Between the steel beam and the headstock chuck which grips the test piece is a small cylinder containing mercury. When the beam is deflected some of the mercury becomes displaced by a piston, and is forced along a glass tube. The position of the mercury in the tube is thus a direct measure of the load on the specimen, and alongside it there are marked scales reading directly in terms of stress, one scale reading in tons load, and a second reading in tons per square inch on the $^1/_{50}$ square inch test piece. To facilitate the accurate reading of the scale a sliding cursor is provided. As shown by our engraving, Fig. 2, the machine is also furnished with an automatic recording mechanism, which enables the operator to prick out the curve of stresses by recording each consecutive reading. Our illustration shows a 100-ton machine arranged for the Brinell hardness and cast iron bending tests. For the Brinell test the specimen is placed at the back of the machine, as indicated at the top of Fig. 2. The ball, which is 5 mm. diameter, is fitted in such a way that the load applied by the hand screw, shown at the top of the engraving, is applied to the beam of the instrument till the required load is reached. The diameter of the depression formed by the ball is then measured by a microscope provided,

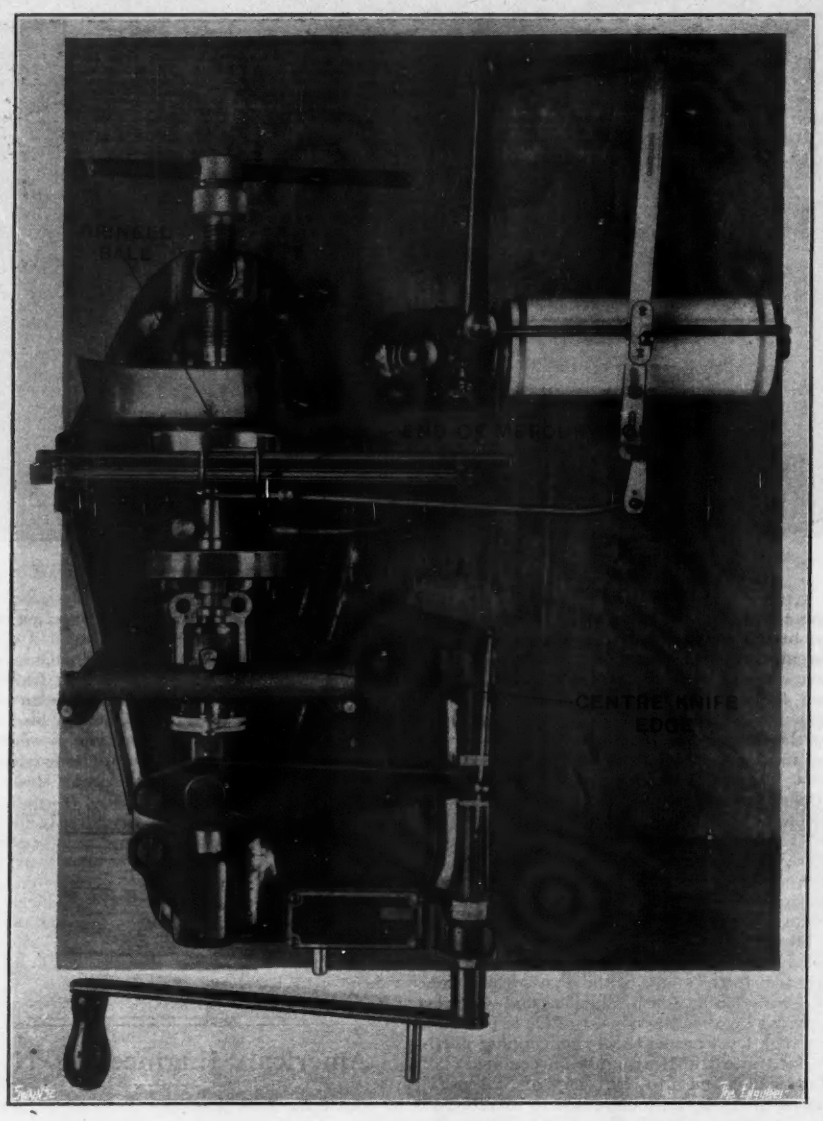


FIG. 2—SMALL SPECIMEN GENERAL PURPOSE TESTING MACHINE—TENSOMETER

the Brinell hardness being found in the usual way by reference to a table. For carrying out the bending test, as shown in Fig. 2, a pair of crescent-shaped castings are fitted to the machine, which carry the outer abutments for the ends of the test bar. The central load is applied by a knife-edge, from the

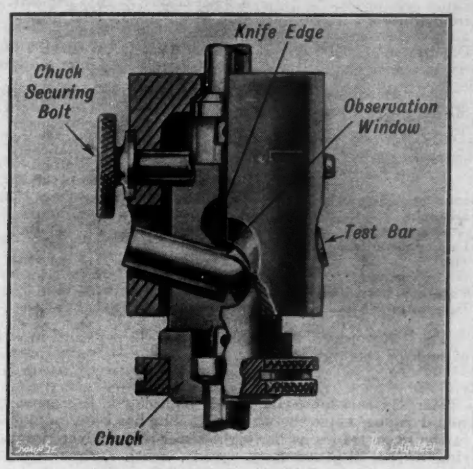


FIG. 3—NOTCHED BAR TEST—TENSOMETER

lever and hand-operated screw in the usual way. The stress per square inch can be recorded graphically up to the breaking point.

For carrying out the notched bar test, the special halved chuck indicated in Fig. 3 is employed,

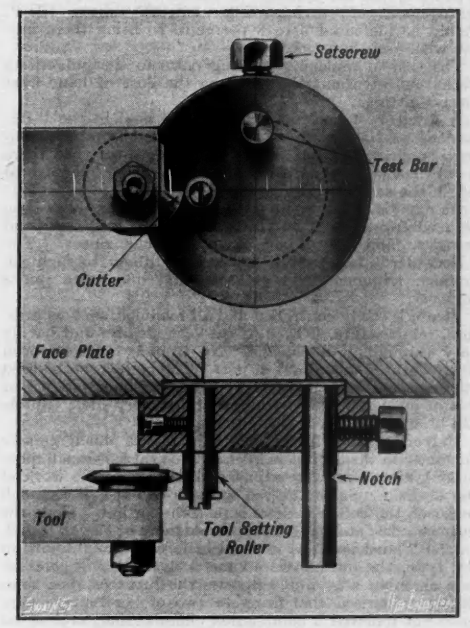


FIG. 4—DEVICE FOR NOTCHING SPECIMEN—TENSOMETER

of which the lower part is employed in the cast iron bending test. As will be seen, the two halves of the outer chuck are temporarily joined by a set screw, the inner halves being held together by a loose ring. In order to be able to set the notch abreast of the knife-edge, an observation window is provided in the outer chuck as shown. The work expended in bending the notched bar is autographically recorded on the drum, and in Fig. 5 we show a series of tensometer records comprising those of five tensile and five notched bar tests of the same steel, having the five different heat treatments shown. This diagram shows very clearly how desirable it may be to correlate the evidence of both tensile and notched bar tests in finding an appropriate heat treatment for a given purpose. As the radius at the bottom of the notch is only $^1/_{100}$in., it will readily be seen that if the notch is not accurately cut, widely differing results can easily be obtained. In order to facilitate the accurate and uniform cutting of notches, the special chuck shown in Fig. 4 has been designed. As will be seen from our engraving, the test piece is fastened in the chuck by a setscrew. The cutter takes the form of a circular disc, on the edge of which the desired notch radius has been carefully reproduced. This cutting edge is renewed by grinding on a nearby radial plane, so that the same profile is always kept. In order to set the cutter a hardened roller is used to set the tool for the final cut. The machine we have described, which is manufactured by the Birmingham Tool and Gauge Company, Ltd., for Tensometer Ltd., has recently found a wide use, not only for steel and cast iron, but for low tensile alloys and plastic materials. Its use has been further extended since our last description appeared by the provision of chucks, enabling stress tests of sheet metal to be carried out, and also shear tests on all materials.

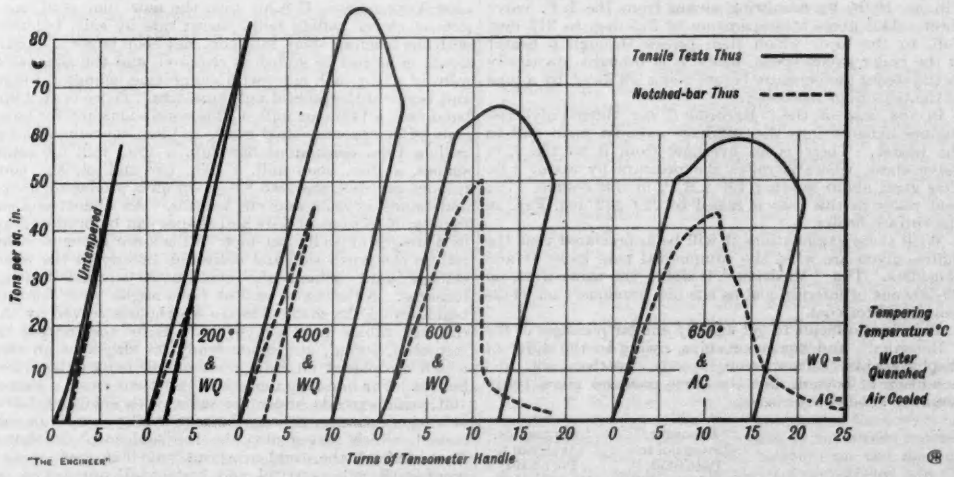


FIG. 5—AUTOGRAPHIC RECORDS—TENSOMETER

THE WATERLESS GASHOLDER COMPANY, LTD.

The stand of the Waterless Gasholder Company, Ltd., 13, Rood-lane, London, E.C.3, is to be held conjointly with Messrs. R. and J. Dempster, of

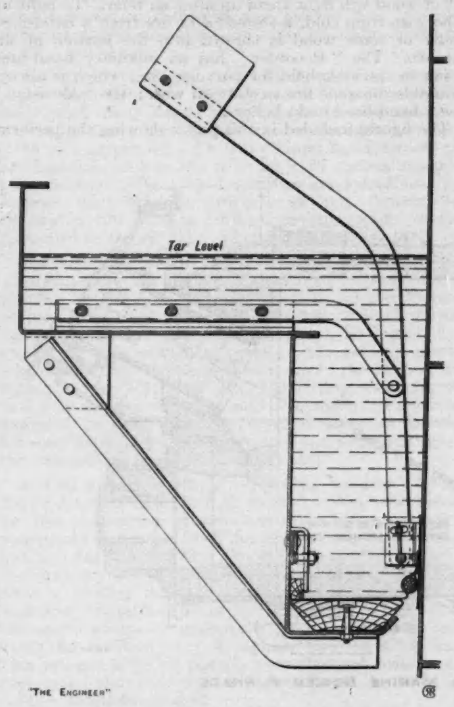


FIG. 6—PISTON SEAL OF WATERLESS GAS HOLDER

Manchester; Robert Dempster and Sons, of Elland, Yorks.; Clayton, Son and Co., of Hunslet, Leeds, and E. Cockey and Sons, of Frome, Somerset, these firms being the licencees for the actual construction of gasholders of this design.

The general exterior appearance of these holders calls for no description, as they are becoming common features of our landscape; but the drawing which we give in Fig. 6 may be of interest through showing how the piston which confines the gas makes a tight joint against the plating of the holder. The joint is made by means of bars, coated with a special fabric, which are pressed outwards by counterweighted levers. These bars are immersed in a seal of tar held in an annular chamber, as shown. Any tar which may trickle down the sides of the holder is collected in sumps at the bottom, and is automatically pumped up into tanks at the top, from which it is distributed to the seal again. An arrangement of rollers prevents the piston from canting over. One of the claims for these gasholders is the rapidity with which they can be erected, one 20,000,000 cubic feet capacity having been put up in Chicago in a little over six months.

THE BRYAN DONKIN COMPANY, LTD.

A wide range of machinery and appliances designed for the production and distribution of high-pressure gas will be displayed on the stand of the Bryan Donkin Company, Ltd., of Chesterfield. It will embrace air and gas exhausters and blowers and gas valves and governors; while on a special gas filling station on an outside stand a high-pressure gas compressor will be demonstrated. Among the exhausters there will be seen for the first time a new type of high-speed multi-blade rotary blower, a feature of which is the provision of floating rings of special design at the ends of the rotor, which keep the blades from actual rubbing contact. The machine is equipped with a by-pass valve which can be set to any desired pressure, and it is automatically lubricated by means of a pressure feed to visible drip lubricators. A new range of machines of this type will be built in various sizes up to 30,000 cubic feet per hour and for pressures up to 5 lb. per square inch. Among the gas valves we have chosen for illustration—see Fig. 7—is the double-faced high-pressure valve of the "Baurer" type, which is supplied for pressures up to 100 lb. per square inch. The design is such that access can be obtained to all working parts for cleaning while the valve is under pressure. The two doors are

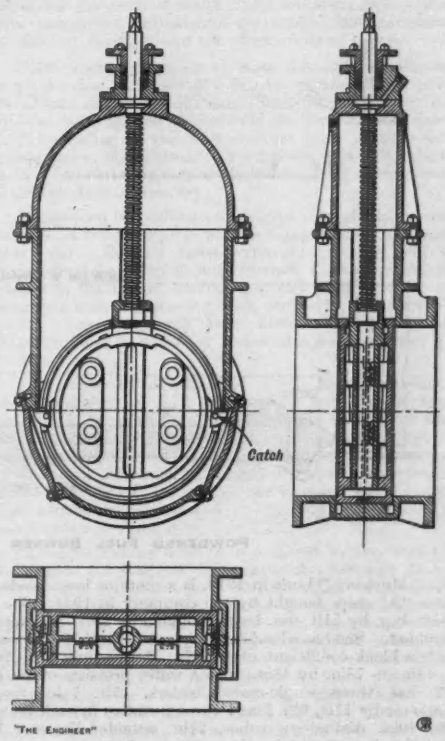


FIG. 7—GAS VALVE—BRYAN DONKIN

separate and they are held against the faces by springs and wedges so that as the valve descends the doors are wedged home. As shown in the drawing, there are side catches, the function of which is to prevent the wedge pieces from coming into action until the doors are in the closed position.

With the proposed use of high-pressure gas for driving motor vehicles, compressor manufacturers have turned their attention to the problem of compressing this gas to the requisite pressure. The Bryan Donkin Company, Ltd., has designed and constructed a four-stage machine which will compress town gas or coke oven gas to 5000 lb. per square inch with a capacity of 100 cubic feet of free gas per minute when running at about 480 r.p.m.

In order to reduce the working parts to a minimum differential pistons are employed, with four stages in two cylinders. The first stage is carried out on the top of the piston of the larger cylinder, and the second stage in the annular space between the cylinder wall and the piston extension. The third and fourth stages are carried out in like manner on the other cylinder.

After compression in each successive stage the gas enters a series of copper tubes, the surface of the tubes being so proportioned for each stage as to extract from the gas the heat of compression before it passes to the next stage. An after-cooler is also fitted. The coils and tubes are surrounded by water, which is continually circulated through the cooling tank and the cylinder jackets. A mechanical sight-feed lubri-

cator supplying a special oil of a high ignition temperature lubricates the pistons and valves. The crossheads run in bored guides in the crank case, and the main bearing housings are cast solid with the frame and fitted with phosphor-bronze bearings, the crank shaft being a solid steel forging. The connecting-rods are furnished with adjustable phosphor-bronze bearings.

After final compression the gas is delivered into a long tube which serves as a separator and removes from the gas any oil suspended therein as a result of its passage through the compressing cylinders. This is drained off by a valve at the bottom and the dry gas passes away at the top of the tube.

The compressor will be arranged for filling specially made steel cylinders with gas at a pressure of 3000 lb. per square inch on a gas-driven motor omnibus which will be demonstrated in the Fair grounds. This omnibus will also be equipped with the Bryan Donkin design of governor to reduce pressures between from 30 lb. and 3000 lb. per square inch to a vacuum of 1½in. water gauge.

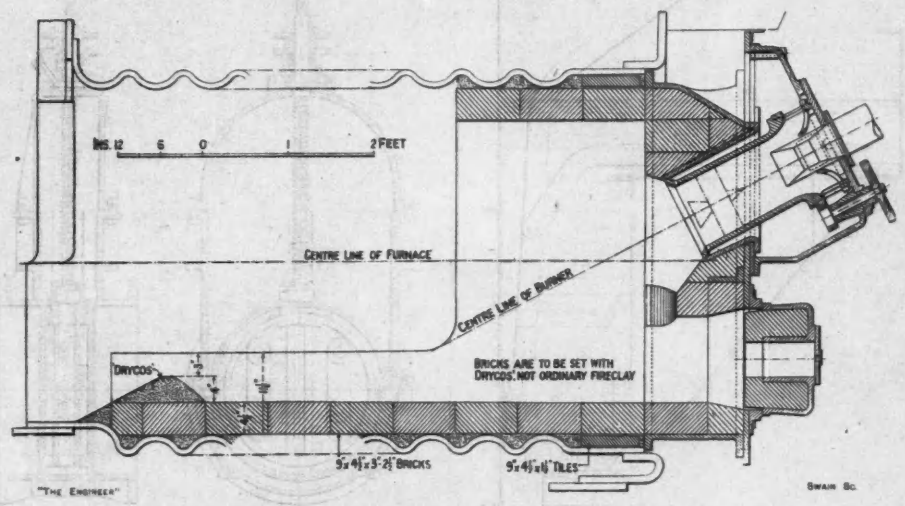
(To be continued.)

Pulverised Coal Firing in Marine Scotch Boilers.*

By W. G. GIBBONS and M. ARTHURSON.

WITH the permission of the owners of the s.s. "Musician" and "Recorder," the Charente Steamship Company, Ltd., the authors have great pleasure in giving their experience and particulars of these ships burning pulverised coal. The information and particulars are obtained from the actual running of the ships.

In March, 1929, after careful consideration of the advantages and disadvantages of the different systems of pulverising and burning, it was decided to fit two of the boilers of the "Musician" with Messrs. Clarke, Chapman and Co.'s system, including electrically driven pulverisers.



POWDERED FUEL BURNER IN A MARINE BOILER FURNACE

The "Musician," built in 1919, is a more or less standard Class "A" ship, bought by the company in 1924. She is 385ft. b.p. by 51ft. 9in. beam moulded by 29ft. 3in. depth moulded. She has a load line displacement of 10,680 tons, with a block coefficient of 0·777. Her engines are 27in. + 44in. + 73in. by 48in., with a water pressure of 180 lb. She has three single-ended boilers, 15ft. 7½in. mean diameter by 11ft. 6in. long; three furnaces in each boiler, 3ft. 10in. diameter; tubes, 2¾in. outside diameter by 7ft. 8in. b.p.; total heating surface, 7668 square feet; fitted with Howden forced draught; no superheat.

The "Recorder," one of nine sisters, was built in 1930, and commenced work in November of that year. She is one of the latest types of ships built to suit the owners' special requirements, and is 420ft. b.p. by 54ft. 3½in. beam moulded by 32ft. 7in. depth moulded; with a load line displacement of 13,000 tons and a block coefficient of 0·75. The engines have cylinders 27in. + 46in. + 77in. by 54in., with a working pressure of 210 lb. per square inch. She has three single-ended boilers, 16ft. 3in. mean diameter by 12ft. long; three furnaces in each boiler, 4ft. internal diameter; tubes, 3¼in. diameter by 7ft. long b.p. The combustion chambers are large, being 3ft. 7½in. long at top and 3ft. 10in. at bottom inside. The total heating surface in the three boilers is 7200 square feet, the capacity of the furnaces 755 cubic feet, and of the combustion chambers 1176·7 cubic feet, or a total combustion space of 1931·7 cubic feet. There are three pulverisers of Clarke, Chapman and Co.'s make, one to each boiler, direct driven by Belliss and Morcom steam engines at 1200 to 1350 r.p.m., according to the type of coal. The fuel feed mains are so arranged that with the spare lengths of pipe supplied any pulveriser can feed other boilers in addition to its own boiler. Hot air for the pulverisers and secondary air for the furnaces is supplied by a fan through a tubular heater in the uptake. The main steam is superheated by a Sugden uptake superheater to about 520 deg. Fah. at the engines.

The only trouble experienced was in keeping the tubes clean and disposing of the dust in both ships. The first difficulty was overcome by a special arrangement of steam blower, so that the tubes can now be blown in the same way as in an ordinary job with smoke tube superheaters. The second difficulty was got over by means of a water pressure ejector. In both ships pockets are provided to the smoke-boxes with a slide to open and shut. In the "Musician" the dust is drawn off into an ash bucket, and then taken out by the suction hose and expelled overboard by the ejector. In the "Recorder" special connections to these pockets, to which a flexible hose is attached, are provided, and the dust expelled overboard. Further, by means of suitable nozzles on the hose, dust is picked up anywhere about the stokehold or boiler tops and expelled overboard, just as a vacuum cleaner works, except that the dust is not stored or filtered.

On the first voyage of the "Musician" a little trouble was experienced with some kinds of slag, owing to it being "sticky" and inclined to set very quickly when cold air got to it. This was overcome by supplying a small quantity of limestone, which keeps the slag fluid as in blast-furnace practice.

The "Recorder" had the advantage of experience gained with the "Musician," and she has given no trouble after the first run. The trouble that was experienced was due to trying what was believed to be an improved type of burner, but experience proved it was not so good as the first design. The only difference in the burners now is that the angle of the burners has been decreased from 45 deg. from the horizontal in the "Musician" to 27 deg. in the "Recorder." Originally, five rings of brick were fitted right round the front ends of the furnaces, but these have gradually been reduced to three rings. The present general arrangement of the furnace is shown in the accompanying illustration. In addition to protecting the front end of the boiler from excessive heat, it has been found that some bricks there are useful to "light up" from when fires are put out temporarily, when lying at anchor or when standing by. As a rule, after being under full steam for some little time, so that everything is heated up, and provided the furnace doors are shut (and there is no reason to open them, except for cleaning), the burners will light up off the incandescent bricks as long as 30 minutes after being shut right off, whilst a handful of greasy waste or a bit of wood will light them up after an hour. To light up otherwise from cold, a shovelful of fire from a hand-fired boiler or some wood is thrown into the bottom of the furnace. The "Recorder" has an auxiliary hand-fired boiler in the stokehold for port use, &c., which is always available for some fire to start off with; the "Musician" has a hand-fired main boiler.

The figures included in this paper showing the performance of the ships are not given in detail separately, such as for propulsion only, but include all auxiliaries, heating, lighting, &c., for all purposes; in other words, the total weight of coal used at sea when steaming. It may be emphasised that the "Recorder" and her sisters are just straightforward jobs with only such auxiliaries as will pay on their cost and upkeep. All exhaust steam is used up in the feed water and the lagging of boilers, pipes, cylinders, &c., is very thorough. In the eight sister ships, the surface heater absorbs all the exhaust steam and rises to a pressure of only 1 lb. to 3 lb. This is brought up to 8 lb. to 10 lb. by admitting steam from the L.P. valve chest. This gives a temperature of 215 deg. to 217 deg. Fah. to the feed, which then passes through a heater in the boiler steam space, where it is brought practically to the steam temperature before being led down by a pipe to the bottom of the boiler.

In the case of the "Recorder" her three pulveriser engines exhaust into the auxiliary exhaust main and to the heater. There is an overflow from it to the L.P. valve chest, where it raises the pressure by about 1 lb. This gives about another 100 I.H.P. in this engine. The feed water in this case is raised to 220–232 deg. Fah. in the surface heater.

With these explanations it will be appreciated that the figures given are what the commercial man looks at and considers. The "Musician" is doing the same work on 29–30 tons of inferior coal as she did previously on 34–35 tons of better coal.

It is very difficult to get exactly similar passages of the "Recorder" and her sister ships, owing to the different displacements, consumption, speeds, weather, slip and condition of bottom, but the three passages given below are very good comparisons.

	s.s. "Recorder." Liverpool to Port Said, May 30th, 1931.	s.s. "Contractor." Liverpool to Port Said, May 9th, 1931.
Distance	3179 knots	3186 knots
Average speed	11·4 knots	11·3 knots
Daily consumption	37·7 tons	40 tons
Slip	5·3 per cent.	5·6 per cent.
Draught mean	21ft. 3in. leaving	21ft. 1½in. leaving
Total coal burned on passage	439 tons	468 tons
Description of coal	Staffs. slack	Washed Yorkshire mixed

The "Recorder" shows a saving of 37 per cent. in cost of fuel for this passage.

	Liverpool to Corpus Christi, Oct. 19th, 1931.	Liverpool to Galveston, Aug. 28th, 1931.
Distance	5081 knots	4958 knots
Average speed	10·8 knots	11 knots
Daily consumption	37·7 tons	36·6 tons
Slip	9·2 per cent.	6·7 per cent.
Draught mean	15ft. 0in.	17ft. 4in.
Total coal burned on passage	739 tons	686 tons
Description of coal	Bolsover slack	Washed Yorkshire mixture

The "Recorder" shows a saving of 28 per cent. in cost of fuel for this passage.

	s.s. "Recorder," New Orleans to Liverpool, July 27th, 1932.	s.s. "Rancher," Mobile to Liverpool, Aug. 26th, 1932.
Distance	4543 knots	4587 knots
Average speed	11·7 knots	11·5 knots
Daily consumption	38 tons	45·2 tons
Slip	4·3 per cent.	4·9 per cent.
Draught mean	23ft. 2½in.	22ft. 1½in.
Total coal burned on passage	614 tons	751 tons
Description of coal	Derbyshire slack	Derbyshire

The "Recorder" shows a saving of 29 per cent. in cost of fuel for this passage.

The "Recorder" has just completed her seventh round voyage since she was built. She has been employed in the same trades as her eight sister ships. Her running time at sea, displacements, speeds, weather, time in port, &c., average practically the same as the other eight sister ships. The last seven completed voyages of the nine ships have been taken and show that the "Recorder" has saved 24·8 per cent. in cost of fuel. Since she started, the efficiency has gradually gone up each voyage, as experience has been gained in working details, hence her latest voyage shows the best all-round result.

The eight sister ships give 62–66 I.H.P. per ton per day, and the "Recorder" 70–78 I.H.P. per ton per day, depending on the quality of the coal. Owing to the arrangement of valve setting used, the above I.H.P. should be increased 6 to 8 per cent. to bring them into line with usual practice.

The cost of replacing wearing parts in the pulverisers works out at about the same as the cost of hand-fired furnace fittings.

A number of analyses made of the coal in the "Recorder" and the samples of ash obtained from the combustion chambers, tubes, and uptakes, show that there is only 1·4 per cent. of the combustible matter in the coal left in the ash.

As regards engine-room crew, the "Musician" has been reduced from fifteen to thirteen firemen, trimmers, and greasers, and given one extra junior engineer. The "Recorder" has twelve, instead of fifteen to eighteen firemen, trimmers, and greasers, and one extra junior engineer.

Steam is easily controlled and all readings, such as pressure, temperature, CO_2, &c., are very steady, and hardly vary throughout a passage. No trouble is experienced when working in and out of port. The boilers can be fired much harder than with hand firing, without trouble or loss of efficiency. Speaking generally, very little trouble has been experienced with either ship.

Pulverised coal firing in a ship makes much greater demands on the engineers in charge, as there is much more to look after and keep adjusted, but it eases the work of the firemen. So far as the authors can see, it is much easier on the boilers; there is no "firebar line" along the furnace sides, and the furnaces scale more or less all round. In the "Musician," as is usual in forced draught jobs of her type, the owners were constantly renewing combustion chamber stay nuts opposite the furnaces, but since fitting pulverised coal firing to two of her boilers, they have not renewed a combustion chamber nut, and so far there are no signs of such repairs being required in these two boilers, though they are doing over 75 per cent. of the work of the ship.

* Institute of Marine Engineers, January 31st, 1933. Abstract.

COMPREHENSIVE STEEL WORKS.

THE MacDonald works of the Carnegie Company, near Youngstown, U.S.A., with the new 10in. mill, consists of eleven rolling mills placed side by side, together with the machine shop, roll shop, and hoop factory. Additional mills can be added as required, and the site has a railway along each side, with connecting sidings through and between the several mill buildings. There is an 18in. band mill, a 14in. bar mill, a 12in. continuous mill for large coils of hoops and strip steel, a 12in. continuous strip mill, a 10in. continuous bar mill, a 10in. mill for small shapes, a 10in. hoop mill, a 10in. bar mill, an 8in. continuous bar mill, and two 8in. hoop mills producing hoops and bands in coils and cut lengths. An almost endless variety of sections of bars and shapes can be produced up to a weight of 55 lb. per foot. Billets are brought in by rail on the north side and delivered directly at the billet storage yard behind the continuous oil-fired heating furnaces. Adjacent to and at right angles with the mill buildings on the south side are warehouses served by the run-out tables and conveyors. Here the output is inspected, sorted, and made ready for shipment on cars which are placed on sidings extending across the warehouses. For handling material other than steel, a tunnel 16ft. wide extends under the mills, with shafts and lifts at various points. Storage battery trucks operate in this tunnel, which serves also the roll and machine shops. Each mill has the usual overhead travelling crane equipment. All rolls, vertical and horizontal, are driven by electric motors, and the more recent mills are fitted with elaborate appliances for speed control and automatic action of the tables and the cooling bed movements. For instance, any desired number of bars can be deposited simultaneously on the bed, and held for a given time before being thrown off the bed. The photo-electric cell, or "electric eye" principle is used to control certain of the conveyors.

Railway and Road Matters.

THE London Passenger Transport Bill passed the Report stage in the House of Commons on Monday and its third reading on Tuesday.

THE report by Mr. Roger Gibb on the future policy as to the railways of Kenya, Uganda, and Tanganyika Territory, has been published as a Blue Book, Cmd. 4235.

THERE have hitherto been two signal-boxes at the Corkickle Station, Whitehaven, and two at Brigham between Workington and Cockermouth. By a re-arrangement of the roads and signals at both stations the London, Midland and Scottish Railway has put all the work at each place into one box instead of two, as previously.

ACCORDING to the Board of Trade Returns the value of the locomotives exported during the twelve months ended December 31st last, was £305,958, as compared with £1,496,869 in 1931; the corresponding figures for the carriages and wagons shipped were £748,757 and £2,113,605, whilst the rails were £389,975 in 1932, and £913,347 in 1931.

PLANS for an extension of the automatic street signals from Oxford-street through New Oxford-street and High Holborn to Kingsway, are now being examined by the Ministry of Transport, and it is hoped to have them in operation within a few weeks. The system selected is similar to the one already working from the end of Tottenham Court-road to Marble Arch.

IT is officially announced that Mr. P. D. Michôd, at present the principal assistant to the signal and telegraph engineer, London, Midland, and Scottish Railway, has been appointed to the new office of assistant signal and telegraph engineer. He will be succeeded in the former appointment by Mr. W. Wood, electrical engineer, Scottish Area, London and North-Eastern Railway.

AT an inquiry under the Road Traffic Act at the Metropolitan Traffic Commissioner's Court on February 8th, Mr. Ashton Davis, chief commercial manager, L.M.S.R., said that on that line only 11 per cent. of passengers were carried at standard fares, and 30 per cent. of the revenue was from standard fares. The remainder was from special fares—season, cheap day and half-day excursions, week-ends, period, and other concession tickets.

ON Tuesday last a 250 H.P. oil-electric rail coach, built by Sir W. G. Armstrong-Whitworth (Engineers), Ltd., ran experimentally as an express "train" between London and Birmingham on the L.M.S., in preparation for a regular service which is to carry guests of the makers and Shell-Mex and B.P., Ltd., between London and Birmingham during the Fair. The oil-electric train will be "sandwiched" between regular L.M.S. expresses, and will have therefore to keep to express schedule.

THE *Southern Railway Magazine* for January gives some particulars as to what that railway has done during the ten years that have elapsed since it was formed under the Railways Act, 1921. New branches of railways have increased the length of "open line" by 40 miles; electrical operation has been increased by 723 miles, to a total of 970 miles; twenty-four new stations have been built and thirty-eight rebuilt; 277 locomotives have been built, and 1085 carriages and 14,019 wagons.

SO successful have been the experiments made by the L.M.S. Railway with the "Warehouse on Wheels"—mobile goods warehouses converted from parcels vans or passenger vehicles—that the company has decided to augment this service with twelve more units. These mobile warehouses are stationed in wayside goods yards adjacent to a rail siding, so that freight can be loaded direct to and from rail wagons, and are proving of great value at places where there is no warehouse or where the existing accommodation is fully occupied.

AT the annual winter dinner of the Permanent Way Institution the other evening, Mr. Frank Pick, of the "Underground" system, spoke of the experiments now being made to increase the length of rails from 60ft. to 90ft., and said he wondered that the change had not been made earlier. Mr. R. Carpmael, of the Great Western Railway, in responding to the toast proposed by Mr. Pick, said that there were difficulties. The manufacturers, for instance, had to install new plant and specially long wagons were required.

ON Tuesday afternoon the Prince of Wales paid a visit to the new extensions of the Piccadilly Section of the London Electric Railway, particularly in order to see the latest type of electric traction equipment, which is entirely of British design and manufacture, the mercury arc rectifier equipments, including switchgear, high-speed circuit breakers and control apparatus on the Northern Extension, being made by the British Thomson-Houston Company, Ltd., and those for the Western Section by the General Electric Company, Ltd.

THE directors of the London, Midland and Scottish Railway announced on February 8th that the further heavy contraction in receipts prevented any dividend being paid on the ordinary stock for 1932. That means, incidentally, that the company's prior-charge stocks lose their trustee status for new investors; a year ago Chancery trustee status was retained by a dividend of ¼ per cent. on the ordinary stock. The receipts from railway working fell by £4,716,000, which was, in part, met by a reduction of £2,680,000 in working expenses.

THE station at Tiverton Junction is one of those which the Great Western Company is giving four lines of way, instead of two, by providing an up and a down platform line and leaving the original running lines to act as through roads. On Saturday night last a football special was on the down platform road when it started, presumably against the signal, and ran into a siding and collided with the buffer stops. The signalman had, at that time, accepted an express on the down through line and, fearing that that line might be obstructed, he restored his signals against the express and used the detonator-placing machine, which he can operate from the box, so that a fog signal was placed on the rails. Those warnings were effective and the express was pulled up.

Notes and Memoranda.

GILDING metal has been used with satisfactory results for filling up blow-holes in gun-metal castings. The effect is good, both as to soundness of weld and as to colour matching.

AN electric soldering iron stand has been introduced in the United States which has two cradles, one of which maintains the iron at minimum soldering temperature; the other rapidly brings it up to soldering heat.

IN a recently published paper, Mr. P. H. Mitchiner, of the consulting surgical staff of St. Thomas's Hospital, has made a very convincing plea for the routine use of tannic acid in the treatment of burns and scalds.

IN a recent lecture delivered at the Royal Institution, Professor E. N. da C. Andrade said that in modern electric lamps over 90 per cent. of the energy supply was sent out as radiation, but of that, even in the very best lamps, only about 10 per cent. was visible to the human eye, the remainder being invisible infra-red or heat radiation, which was pure waste so far as illumination went.

THE relative permanence of a liquid glue may be determined by storing it for about one month at a temperature of 37 deg. to 38 deg. Cent. If the glue remains free from signs of decomposition, and is unaltered in general appearance at the end of this period, then, says Mr. D. Jennings, it should satisfy the most exacting requirements demanded, provided that its strength is satisfactory.

A NEW method of casting ingots is described in *The Iron Age*. It consists of casting in a clover leaf-shaped mould, and cutting off the three wings, then discarding the central portion. Ingots weighing 1000 lb., 2000 lb., 3000 lb., and 10,000 lb. have all been cast with excellent results. To date over 300 tons of tool steel have been manufactured by a firm by this process in a number of different grades and tried out experimentally at the mill and by actual use.

ACCORDING to the *Iron Age*, the 18 per cent. tungsten, 4 per cent. chromium and 1 per cent. vanadium type of high-speed steel stands pre-eminent as best suited for threading dies. This steel is used in the carbon range of 0·68 to 0·72 per cent. for bolt chasers and for some pipe applications, and in the 0·58 to 0·62 carbon range for pipe chasers. The 18–4–1 and the low-vanadium types possess the desirable property of not decarburising readily in the threads during heat-treatment, or when quenched in air, air blast, oil or hot-liquid baths.

A TRAVELLING mercury rectifier station has recently been constructed by the Siemens-Schuckert Company, for the Belgian Société Nationale des Chemins de Fer Vicinaux to meet the extra power requirements of local railways caused by traffic. The equipment can be hauled by a tractor to any particular point of the railway system, where it can readily be connected up to the H.T. system for converting to 610 volts D.C. The equipment comprises two 350 ampère rectifiers and a transformer-converter designed to deal with twenty-eight steps of pressure between 4400 and 15,000 volts, all necessary changes in the connections being made externally.

A LENINGRAD institute, according to *The Chemical Trade Journal*, has recently worked out a new process for the production of bromine from the carnallite of Solikamsk, and it has been decided to erect new bromine factories for working this process. A further project is the recovery of bromine from the waters of Kolunder Lake in Eastern Siberia. The central laboratory of the Walchow Aluminium Trust has discovered a method for the manufacture of chemically pure hydrofluoric acid from the residues of the manufacture of aluminium. This process is to be put on a commercial scale in the expectation that the output will cover the whole of Russia's needs in hydrofluoric acid.

SOME tests on a welded steel transmission pole are given in the *Electrical Review*. It was 44ft. 3in. high overall, and the base was 6ft. below ground level. The section at the base was 6in. by 16¾in., and at a point 10ft. from the top 6in. by 8in. An earth foundation with standard wood kicking blocks was employed, and the following loads were applied:—3 of 3500 lb. vertically, and 3460 lb. horizontally at the pole top across the track; 3 of 3500 lb. vertically and 900 lb. horizontally at the top along the track. The maximum movement of the base was 4¼in. at ground level, and the deflections at the top were 52¾in. across track and 43in. along track. In spite of the very large deflections there was no measurable permanent set in the pole.

A MICRO-WAVE wireless telephone service between the Vatican City and the Palace of His Holiness the Pope at Castel Gandolfo, near Rome, was officially opened by the Pope on Saturday, February 11th. The installations at the two stations, which will be operated on a wave length of 60 cm., have been personally supervised by Marchese Marconi, who during his recent visit to London described his new micro-wave apparatus to the members of the Royal Institution of Great Britain. The service opened last Saturday is of considerable interest, as the route between the two points, a distance of over 12 miles, is entirely over land, and owing to the intervening trees in the Vatican garden and in the avenue built over the Gianiculum Hill, situated about 4 miles from the Vatican, there is no actual clear vision between the two places.

THE unusual type of tower adopted in the design of the George Washington Bridge is discussed in a paper before the American Society of Mechanical Engineers by Mr. L. S. Moisseiff. The entire load of the bridge is applied at the top of the inner columns of the tower, and is distributed between all columns as the stress proceeds downward, until, finally, the reaction on the masonry is practically uniform. The paper demonstrates how this tower was analysed; methods used to test, analytically, the efficiency of the design are related; stress-strain measurements on a celluloid model of a tower bent are described, and results are given of stress-strain measurements on the completed towers, which show the distribution of the load in the tower columns. These final measurements demonstrate the agreement between engineering theory and the actual behaviour of the structure.

Miscellanea.

THE patent fuel output of South Wales last year was approximately 840,000 tons, some 753,950 tons of which was exported.

A NEW seam of coal has been discovered in Lancashire, some 2 square miles in area, and estimated to contain some 20 million tons.

ACCORDING to Mr. B. Pochobradsky, the overall thermal efficiency of large power stations equipped with steam turbines has reached 24 per cent.

THE pumping plant for the new dry dock of Swan, Hunter and Wigham Richardson, at Wallsend-on-Tyne is to be supplied by Drysdale and Co., of Glasgow.

REPRESENTATIVES of Catchment Boards constituted under the Land Drainage Act, 1930, recently met to discuss the formation of an Association of Catchment Boards.

BRICK-FILLING adds about 75 per cent. in strength to steel structures, the United States Bureau of Standards has just found, after conducting several experiments with actual construction columns.

THE production of motor vehicles in the United States in 1932 totalled 1,370,728 units, a drop of 1,019,010 under the 1931 output, according to reports received from manufacturers by the Bureau of the Census.

SPECIAL tank outfits with centrifugal pumps, which will spray a solution of sodium arsenite, are being bought by the municipality of Baghdad for fighting locusts. These machines, which are of English make, will also be used for street watering and washing.

ACCORDING to some remarks made by Mr. C. S. Davidson at an informal meeting of the Institution of Electrical Engineers, 80 per cent. of the units generated in this country are from large selected stations, which naturally need no grid system of distribution, so that only 20 per cent. is sent over this elaborate system.

WITH the exception of aluminium production, Japan has now a completely representative electro-chemical industry, says Mr. S. Makishima. Electric power consumed by this industry amounts to 4200 million kWh a year, for the electrolysis of water for ammonia synthesis, the manufacture of calcium cyanamide, the manufacture of calcium carbide, and the electrolysis of brine.

NEW Soviet orders for German industrial products, to a total value of 65,000,000 m., are announced at Frankfurt, says *Machinery Market*. The orders include 70,000 tons of tubes for the extension of the Russian oil industry. The financing of the business has been secured under guarantee of the German Government, and it is said that a credit of forty-eight months will be given on an average from the date of delivery.

ACCORDING to *Industrial Britain*, the dock extension scheme at Southampton will be completed by the end of this year. Beyond these extensions, which will cost approximately £13,000,000, further works are contemplated in the future, including a new jetty about a mile long and a second graving dock similar to that now being built. The jetty will have berths aggregating some 10,000ft., and a depth of water alongside of from 40ft. to 45ft.

THE gunboat "Sandpiper," which has been built for the Admiralty by J. I. Thornycroft and Co., of Southampton, is being shipped to Shanghai in sections on board the P. and O. liner "Chitral." The "Sandpiper" is 160ft. in length, with a beam of 30ft., and a displacement of 185 tons. She will be propelled by twin-screw engines developing 600 H.P., giving her a speed of 11½ knots. Her armament includes a 3·7in. howitzer and a six-pounder quick-firing gun.

THIRTEEN entries have been received by the Aero Club de France for the new International Challenge Trophy, known as the Deutsch de la Meurthe Cup. The race will be held on May 28th next, in the district adjoining Paris known as "la Beauce," a large open section of country lying to the south-east of the French capital, in the direction of Orleans. It is intended to be an international speed competition for land planes and sea planes (and amphibians) over a course of at least 2000 kiloms. This distance will be divided into two flights of 1000 kiloms. each, and a landing between them of not more than 90 min. will be allowed.

THE experience of the Industrial Welfare Society is that most small employers hold the view that it is not possible for them to make any organised provision for the health, comfort, well-being, and security of their workpeople. For some reason such employers associate welfare work with canteens, rest rooms and sports pavilions instead of regarding it as something to be applied to the conditions of the ordinary working day. The Society is therefore arranging a conference at the Hotel Victoria on Tuesday, March 7th, when the directors of some of these smaller firms will explain how they have successfully introduced various forms of welfare work and will answer questions on their schemes. Full details can be had from the Secretary, Industrial Welfare Society, 51, Palace-street, S.W.1.

SPEAKING at Wellington, Salop, on January 20th, Sir William Ray gave an interesting example of the advantage of buying British in a case where such a course of action involved the London Council in a somewhat larger initial expenditure. In the case of the Lambeth Bridge, it would have been possible, by using foreign steel and granite, for the work to have been done at a saving of about £20,000 in the purchase of this material. The wages, however, paid to British workers as a result of using British steel and granite amounted approximately to £170,000, representing probably the continuous employment of 1000 people for a year. If foreign steel and granite had been used these workers would have lost their employment, and the cost of maintaining them on the Unemployment Fund, or through the Public Assistance Authorities, would have been approximately £52,000, or a total sum of £32,000 in excess of that involved through placing the contract at home. Accordingly, the net national saving through buying British was £32,000, instead of an apparent loss of £20,000.

ELDERSLIE GRAVING DOCK—BOX ENTRANCE GATE

SIR WILLIAM ARROL AND CO., LTD., GLASGOW, ENGINEERS

(*For description see page* 174.)

FIG. 1—GATE FLOATED INTO POSITION

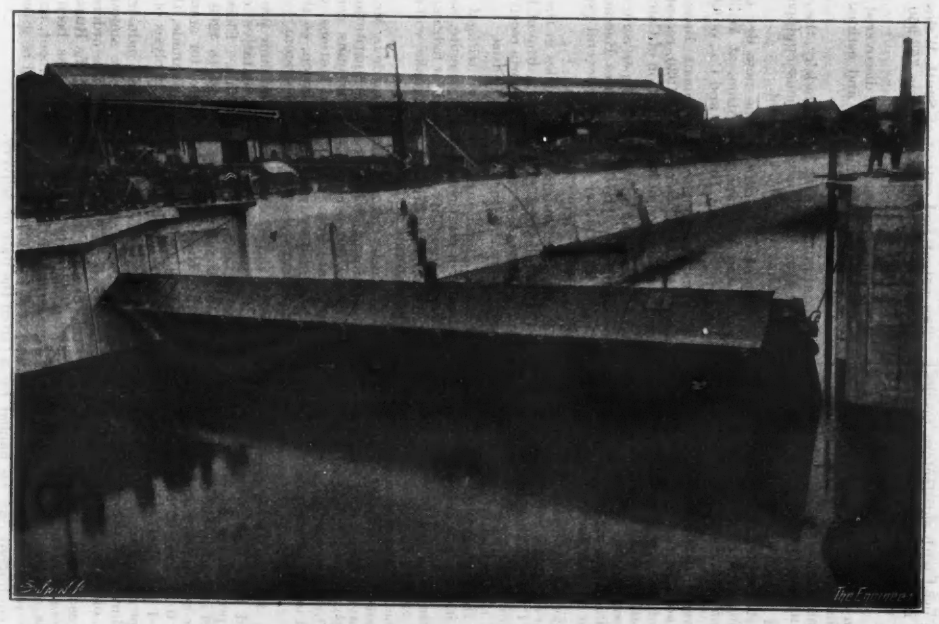


FIG. 2—RAISING GATE INTO TOP POSITION

FIG. 3—GATE RAISED—LOOKING TOWARDS DOCK

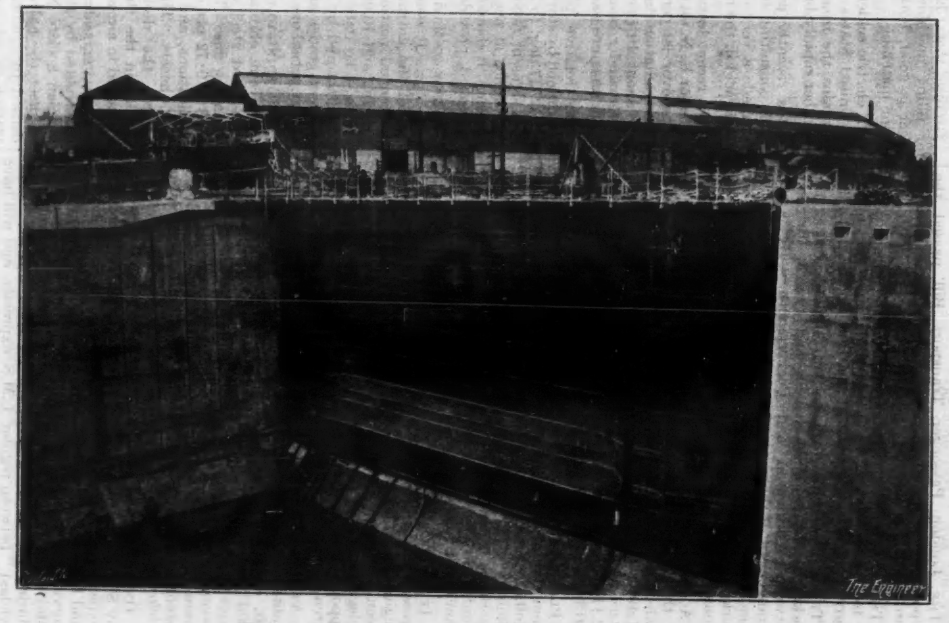


FIG. 4—GATE CLOSED—LOOKING TOWARDS DOCK

The Engineer

FEBRUARY 17, 1933.

VOL. CLV. No. 4023

Contents.

THE ENGINEER, February 17th, 1933. PAGE

A SEVEN-DAY JOURNAL .. 159
THE RIO CINCA POWER PLANT. (Illus.) .. 161
JIGGING CONVEYORS. (Illus.) .. 162
THE NEW DUNSTON POWER STATION. No. II. (Illus.) .. 164
LETTERS TO THE EDITOR—Oil-electric Locomotives .. 165
AMERICAN ENGINEERING NEWS .. 165
SIXTY YEARS AGO .. 165
THE BRITISH INDUSTRIES FAIR AT BIRMINGHAM. No. I. (Illus.) 166
PULVERISED COAL FIRING IN MARINE SCOTCH BOILERS. (Illus.) 168
COMPREHENSIVE STEEL WORKS .. 168
RAILWAY AND ROAD MATTERS .. 169
NOTES AND MEMORANDA .. 169
MISCELLANEA .. 169
LEADING ARTICLES—
Decentralisation of Industries—Transfer of Dexterity .. 171
Dessert .. 172
ATMOSPHERIC POLLUTION IN 1931-1932 .. 172
LITERATURE .. 173
BOOKS RECEIVED .. 173
BOX GATE AT ELDERSLIE DOCK. (Illus.) .. 174
THE DESIGN OF KILNS FOR SEASONING TIMBER .. 175
ROTARY PULVERISED FUEL FURNACE FOR CAST IRON. (Illus.) 175
PORTABLE ELECTRIC GENERATOR. (Illus.) .. 176
THE "NEW MANCHESTER" SAW. (Illus.) .. 176
SAFE LOAD INDICATOR FOR CRANES. (Illus.) .. 176
NEW MECHANICAL LEAD JOINT .. 177
NEW ELECTRICAL INSTRUMENTS. (Illus.) .. 177
INGOT TURNING LATHE. (Illus.) .. 177
TECHNOCRACY .. 177
LLOYDS' REGISTER OF SHIPPING .. 178
SYDNEY HARBOUR BRIDGE—THE INSTITUTE OF METALS—THE IDEAL FOREMAN .. 178
CANADIAN ENGINEERING NEWS .. 179
PROVINCIAL LETTERS .. 179
BRITISH STANDARDS INSTITUTION .. 181
PERSONAL AND BUSINESS ANNOUNCEMENTS .. 181
CONTRACTS .. 181
CALENDARS .. 181
CURRENT PRICES FOR METALS AND FUELS .. 182
FRENCH ENGINEERING NOTES .. 183
BRITISH PATENT SPECIFICATIONS. (Illus.) .. 183
FORTHCOMING ENGAGEMENTS .. 184
EIGHT-PAGE SUPPLEMENT—THE BRITISH INDUSTRIES FAIR AT BIRMINGHAM.

NOTICES TO READERS.

**** *If any Subscriber abroad should receive* THE ENGINEER *in an imperfect or mutilated condition, he will oblige by giving prompt information of the fact to the Publisher, with the name of the Agent through whom the paper is obtained. Such inconvenience, if suffered, can be remedied by obtaining the paper direct from this office.*

**** *For Subscription rates, see page 2 of Advertisements.*

**** *All letters intended for insertion in* THE ENGINEER *or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

**** *No undertaking can be given to return drawings or manuscripts; correspondents are therefore requested to keep copies.*

DECENTRALISATION OF INDUSTRIES.

A FEW days ago the statement was made that Mr. Henry Ford was endeavouring to increase the number and geographical distribution of works that supplied his Detroit factory with material. Almost at the same time, Mr. T. D. Barlow, President of the Manchester Chamber of Commerce, speaking at a dinner in Manchester, urged that city to seek the augmentation in number of small works—works employing no more than thirty or forty hands. He suggested that in the past Lancashire had thought too much in terms of big industries, and that it was necessary for it to change its views. These two reports, displaying a tendency so greatly at variance with the doctrines of recent years, deserve more than passing observation. The objects aimed at by Mr. Ford and Mr. Barlow may be very different, but the result is of the same kind—production in multiple, relatively small factories, instead of solitary, immense establishments.

Industrial economists have found little difficulty in proving that concentration of production reduces costs of manufacture, partly on account of a smaller managerial organisation and the reduction of on-costs, and partly by the removal of the delays of communications and the diminution of the charges for transport. Yet the large factory is still the exception rather than the rule. According to a recent official survey only 421, out of 127,768 factories in the United Kingdom, employ more than one thousand workers, and factories in which less than 500 persons work number no less than 126,398. It will be remembered that Mr. Ford has gone so far that he not only has his own blast-furnaces and steel works on his manufacturing sites, but even makes his own glass. We may recall that Webb pursued the same principle when he endeavoured to produce the bulk of the material needed by the London and North-Western Railway at Crewe. The fact that within quite recent years a great deal of the Crewe plant has been closed down is not without significance in the present connection. It is probable that never again will a British railway company roll its own rails. In the motor car industry of this country, Dagenham being excepted, there has never been any attempt to effect intense concentration, and in one notable example, at least, the main factory is engaged almost as much on the assembly of parts purchased elsewhere as on the production *ab initio* of the details required. In this case the parts are manufactured by quite independent concerns, each under its own management, and responsible to its own shareholders. In others, the principle of rationalisation has led to the amalgamation of several firms into a single giant organisation, sometimes with the result that several redundant works have been closed and manufacture concentrated in only two or three centres. As opposed to this tendency towards concentration, we have the extraordinarily interesting development of "detail" factories in the London area. Dozens of these relatively small works are springing up around the new highways where they are independent of railway service, which, in the past, was a controlling factor in the selection of factory sites. This new influence of road development on the progress of manufacturing industries is, indeed, one of great importance and one that may call for intelligent guidance. It is not an entirely good thing that factories should tend to congregate on the skirts of great cities, where they must inevitably lead to still greater congestion of population. The dispersal of factories over large areas has much to commend it, and will have more as time goes on and hours of leisure are increased. Observe that Mr. Ford has purchased large areas of cultivable land round Dagenham, and it is understood that he will encourage the development of allotments by his own workpeople. The same idea is adumbrated in connection with his movement in America. He believes that by splitting up factories into smaller units they could be distributed over areas in which farming was also pursued. Hence, in a sense, each works community might be regarded as self-supporting and, at the same time, the people would work under healthier conditions. There is far more scope for that kind of thing in the United States than in this little land, but the proposal raises the thought that even in England there are still many places where small factories might be set up without injury to the countryside and with immediate benefit to the workers. We are not blind to the fact that there are many such works already, and we have not forgotten that, in the history of engineering—particularly of agricultural engineering—many examples may be found. But it is manifest that the tendency is for new factories to collect round the big towns and, where rationalisation is followed up to the hilt, for greater and greater concentration to take place.

By definition, the "Factory system" implies the confluence of a large number of workpeople towards selected centres. Its merits and demerits are well known. But in recent years a vast change which has taken place has rendered the continual development of the colossal factory less essential than it was, say, forty years ago. That change is the progress in communications. Nowadays, the shops of a single company might be distributed over an area of many square miles, and still be as much as, and even more, concentrated than, some of the great, single factories of the past. The telephone has made consultation possible at any distance, and the motor vehicle has reduced the influence of remoteness. Workshop methods have also had a marked effect. Not so long ago it was economical to have the fitting shop adjacent to the erecting shop, because much hand work had to be done. The accepted rule in the laying out of a works was that the material should proceed from department to department without interruption and with as little need of conveyance as possible. But in these days parts and accessories may be collected from a dozen remote centres with the certainty that they will fit into the places intended for them. Moreover, in some instances, the cost of time expended on transport and the cost of transport itself, may be more than counterbalanced by other savings—as, for example, on wages and local rates. Furthermore, a determining factor in the selection of works sites in the past was their proximity to railways, canals, or rivers. The importance of that factor has been reduced by the development of road transport. Nowadays, a factory might be set down in the middle of virgin country, and yet be able to deliver its goods with ease, rapidity, and economy to centres of consumption.

Transfer of Dexterity.

WE say with not a particle of hesitation that not one engineer in five hundred takes any interest in the application of psychology to mechanical crafts. We are far from blaming the majority. Having studied several of the reports issued by the Industrial Fatigue Research Board, which is now the Industrial Health Research Board, and examined various books, papers, and articles on the subject, we have to admit that it leaves us cold. We may be quite wrong; our attitude may be entirely unscientific; we ought, perhaps, to welcome this new science which endeavours to discover the fitness of persons for certain occupations by their ability or otherwise to draw a current Greek ornament or to do "looking-glass" puzzles. It may be old-fashioned to think that the best test of boys and girls' aptitude is to try them on the jobs you want them to do. All that may be so. Even the new scientific jargon which the industrial psychologists are hammering out—as usual, by the distortion of familiar language—may really conceal truths that are of value to industry, and not but little more reliable than those of the now condemned, but once ardently believed, phrenologists. That is as it may be, but until we have very positive evidence to the contrary we shall refuse to believe that any works manager, even in the most enlightened engineering shops in the kingdom, will prefer to select youngsters by the methods which are employed by psychological researchers than by the old but very practical, very simple, very cheap, and very convincing one, of setting them "a job of work."

The latest publication of the Industrial Health Research Board is entitled "Manual Dexterity—Effects of Training," and the first part of it deals with "Transfer of Training in Manual Dexterity and Visual Discrimination." Perhaps the best way of indicating the importance of this research, and at the same time elucidating a certain obscurity in the title, is to mention that from certain experiments made on blindfolded subjects, Dr. C. E. Beeby concluded "that the agency underlying the initial positive transfer was a general mental attitude towards the task, *i.e.*, of 'getting used to' it. He found no positive transfer of specific manipulative habits; indeed, the reverse interference. This interference explains the final negative transfer." Lest this explanation should still leave some doubt as to the object of the research, we hasten to add that all that it does in fact mean is that if a person endeavours to learn simultaneously two types of dexterity which resemble each other—as, for example, ski-ing and figure skating—he may find that they interfere with each other. In short, he will be a worse ski-er if he has learnt figure skating, and a worse figure skater if he has learnt ski-ing, than if he had been content to concentrate solely upon one or other of the selected means of hurting himself. Hence we learn that the "simple belief that 'skill transfers' or that there exists an easily-tested 'general muscular ability' is no longer tenable." Furthermore, we are faced with the fact that "we can never assume that because two skills appear superficially to be similar, acquisition of proficiency in one will transfer to the other." We have, however, one small crumb of comfort, for we learn that, in the opinion of psychologists, "Where positive transfer takes place it is more likely to occur through the agency of emotional attitudes, sentiments, and ideals." It is necessary to warn any manager who may desire to put this principle into practice that such "emotional attitudes" as may be safely employed in the workshop are very milk and water stuff by comparison with the emotions which influence our daily life, or wring our withers on the screen. In fact, the principle means but little more than that if you can get a boy who has been doing one job to take an interest in another job which is somewhat similar, his "emotional attitude" may cause the skill of the first to "transfer" and he will do the work well. To sum up the report in a few words, we quote the final paragraph. "The investigation, therefore, emphasises the importance of intelligent training in muscular performance, especially when accompanied by every possible form of encouragement. It strongly suggests the sterility of mere general practice in a hope of improving manual ability."

Without reproducing the report itself we have endeavoured to lay before our readers the nature of the inquiry and the conclusions to which it has led, and we invite them to say if the end attained is commensurate with the cost of printing, to say nothing of the time and money spent upon the research. It is very doubtful indeed that the results can be carried beyond and outside the very elementary conditions of the tests, for the final sentence just quoted would seem to imply that manual ability is not to be acquired by general practice. That is so contrary to all experience that we hesitate to believe that it could be advanced even by

psychologists who, no doubt, are concerned to overthrow all faiths which cannot be substantiated by their methods of measurement. Let us put it this way. A job of a new kind has to be executed in a toolroom. The manager has the choice between a raw, but intelligent, hand and an experienced craftsman. To which of the two would he allot the work? The answer is not in any doubt. The man who has acquired control of his muscles, and nicety of touch, would unquestionably do the work better than one who had not learnt to use his hands. That is to say, the "general practice" would have given the better workman "manual ability." Moreover, if for no other reason, general practice—unless in the jargon of the psychologists it is given some very restricted meaning—must, by the mere variety which it implies, give a wide range of experience and thus make the possessor fitted to take any work that may be presented to him, with the certainty that he will attain proficiency more rapidly than one who comes to it without any previous experience. All this is extremely obvious. But it is just because it is obvious that we put it forward. It makes us wonder why the research was undertaken.

Dessert.

THE latest discovery, emanating as usual from America, instances once again how manifold are the uses of electricity, in relieving mankind, not merely of labour, but also of pain, discomfort, and trouble. It seems that an engineer attached to the Westinghouse Company of America has discovered that fruit with an acid content will give varying readings on a milliameter when probed with two electrodes, and that a small instrument has been devised by means of which comparative readings of sweetness may be taken. In this instrument, once more, science has provided a cure for one of the minor troubles of life. How often at the dinner table has a guest chosen with the greatest care an orange from the dish to find when the first piece is irrevocably within his mouth that he was deceived into anticipatory pleasure by a false appearance of ripeness? It is but adding to his sense of injury that in deference to the feelings of the hostess, he must, while suffering agonies of acid attack and contemplating with pessimistic gloom the probability of further pain extending far into the small hours of the morning, break up and eat the fruit with every appearance of enjoyment. Such inconvenience will be a thing of the uncomfortable past when the new scientific device is placed upon the market in sufficient numbers. The wary guest, suspecting that from a false idea of economy his hostess has omitted to test the fruit at the time of its purchase, will but have to produce a watch-like instrument from his waistcoat pocket to determine by a scientific test that particular orange best suited to his taste. While hailing with joy this important new advance in electrical technique, may we beg the inventor's permission to bring to his notice another grave omission among scientific devices? Can we hope that when the present invention has been perfected, he will turn his genius to the task of producing an instrument capable of detecting by external appearance alone the state of decay of nuts? Equipped with two such instruments—or perhaps one might be found capable of performing the double function—we should approach the dessert with less trepidation.

Atmospheric Pollution in 1931-32.

By JOHN B. C. KERSHAW, F.I.C.

A LARGE number of the annual returns of atmospheric pollution in towns and cities of the United Kingdom for the twelve months ending March 31st last have been published in the 1931 report of a Southport Auxiliary Observatory, and the author's thanks are due to Mr. Joseph Baxendell for his kindness in supplying an advance copy of this report. The figures reproduced below indicate that a slow, but steady improvement is taking place in the atmosphere of many of our towns, but unfortunately this must be ascribed partly to the slackness of manufacturing industries, especially in the North, and the smoke reformers cannot claim the whole credit for this improvement. The figures for thirty-one towns and cities for the total deposit of solid matter in the year ending March 31st, 1932, have been collected in Table I., and in this table the towns are divided into

TABLE I.—*Comparative Figures for the Total Collection of Solids in Thirty-one Towns and Cities of the United Kingdom during the Twelve Months ending March 31st, 1932, expressed as Tons per Square Mile per Annum.*

	No. of gauges in use.	Tons per square mile per annum.
Group 1.—Under 200 tons (Ten Towns and Cities).		
Rothamsted	1	105
Marple	1	107
Southport	3	113
Bourneville	2	119
Gloucester	1	134
Cardiff	1	160
Halifax	5	164
Wakefield	2	176
Dewsbury	3	185
Edinburgh	3	197
Group 2.—200 to 300 Tons (Sixteen Towns and Cities).		
Wrexham	1	202
Cheltenham	1	211
Salford	3	218
Leeds	5	231
Newcastle-on-Tyne	2	235
Walsall	1	241
Sheffield	3	246
Glasgow	8	252
Stoke-on-Trent	2	253
Leicester	3	258
Birmingham	2	259
Loughborough	1	263
London	13	266
Rotherham	2	267
Rochdale	1	276
Bradford	2	281
Group 3.—Over 300 Tons (Five Towns and Cities).		
Castleford	1	304
Huddersfield	1	323
Burnley	3	408
Liverpool	2	416
Ashington	1	739

three groups, according to the annual amount of the deposit. Group 1 contains ten towns and cities with a total fall of solid matter under 200 tons per square mile per annum, whereas three years ago the number in this group was only four. Rothamsted heads the group with a total of only 105 tons, with Marple and Southport close behind; while Edinburgh, the only city embraced in this group, comes last with 197 tons. Group 2 includes all places which have a total fall of solid matter between 200 and 300 tons, and here, again, some improvement is to be noted, for many of these places record decreases, and there are two or three towns in this group that were formerly included in Group 3. Wrexham heads Group 2 of sixteen towns and cities, with a total deposit of 202 tons, and Bradford closes it with 281 tons; while the principal cities of the country occupy intermediate positions in the following order:—Salford, 218 tons; Leeds, 231 tons; Newcastle, 235; Sheffield, 246; Glasgow, 252; Stoke, 253; Birmingham, 259; London, 266; and Rochdale, 276 tons.

The third group of towns, with deposits over 300 tons per annum, includes Castleford, Huddersfield, Burnley, Liverpool, and Ashington, and here, again, the majority show a lower deposit than in the previous year, with the exception of Ashington, which is a colliery district in Northumberland. This place comes at the bottom of the table, with the enormous deposit of 739 tons per annum, or seven times that of Rothamsted. The writer has thought it worth while to write to the Medical Officer of Health of this district, in order to discover the cause of this very high amount of atmospheric pollution, and the following is an extract from his reply:—

The main sources of the impurities are:—

(1) From the domestic use of coal.

(2) Ash from the use of pulverised fuel at Ashington Colliery.

(3) Smoke and fumes from Ashington Pit heap, which is on fire.

THE LONDON RESULTS.

Turning now to an examination of the figures for London for the past three years. These are collected in Table II., and have been arranged in two groups,

TABLE II.—*The Total Deposits of Solid Matters, Collected in the London Gauges during the Three Years ending March 31st, 1932, Expressed as Tons per Square Mile per Annum.*

Locality.	1929–30.	1930–31.	1931–32.
East and Central Districts:			
Golden-lane	391	408	303
Finsbury Park	284	236	240
Southwark Park	279	256	254
Victoria Park	238	234	195
Archbishop's Park	233	310	373
Averages	285	289	273
West and S.W. Districts:			
Ravenscourt Park	344	461	472
Westminster	299	288	252
South Kensington	228	229	229
Kew Observatory (S.)	180	158	129
Wandsworth Common	169	178	182
Kew Observatory (N.)	151	147	116
Averages	228	243	230
Averages for all eleven stations	254	264	250

according to the positions of the observing stations. Four districts show increased deposits of solid matter in 1931–32, namely, Archbishop's Park, Finsbury Park, Ravenscourt Park, and Wandsworth Common; whereas the remaining seven observing stations show decreases, in some cases quite notable, as, for instance, that of Golden-lane, which has dropped from 408 tons in 1930–31 to 303 tons in 1931–32. This decrease, no doubt, is largely due to the falling off in trade and industry during the twelve months under review, as compared with 1930–31.

The Ravenscourt Park gauge, as in the previous year, has again collected the largest amount of solid impurity, the deposit of solid matter being four times that collected at Kew Observatory, and nearly double that collected in Finsbury Park. As pointed out in the last annual review of these air pollution results, it is quite time that the health authorities in this district of London took some drastic steps to reduce the excessive pollution of the atmosphere which characterises the Ravenscourt Park area, for the Superintendent of the Observations states that there is no doubt whatever about the correctness of the results. It will be noted that the average deposit for the eleven stations given in Table II. for the year 1931–32 is 250 tons, whereas in Table I. the London average is given as 266 tons. The explanation of this discrepancy is that two new observation stations were equipped and put into operation in 1931–32, and the amount of solid deposit collected in these new gauges was in each case high. The new observation station in Horsferry-road, Westminster, collected solid matter equivalent to 379 tons per square mile per annum, while that at Mount-street, in Mayfair, returned the total of 328 tons, and these high totals, of course, increased the general average for the whole of the London area. The districts in the north and north-east of the new generating station in Battersea Park are now well provided with observation stations for the measurement of air pollution, and it will be of considerable interest to note what effect the starting up of this enormous plant will have upon the soot and dust fall results in 1932–33 in these districts of the Metropolis. The air pollution figures for 1932–33 should therefore prove of exceptional value in settling the extent to which modern super-power stations contribute to the pollution of the atmosphere even when equipped with the most elaborate dust-catching and washing plant for treatment of their waste gases.

Table III. contains the figures for the sulphur acids

TABLE III.—*The Total Amount of Sulphur Collected by the London Gauges during the Three Years ending March 31st, 1932, Expressed as Tons SO_3 per Square Mile per Annum.*

Locality.	1929–30.	1930–31.	1931–32.
East and Central Districts:			
Golden-lane	42	47	45
Finsbury Park	32	27	30
Southwark Park	32	31	30
Victoria Park	26	26	22
Archbishop's Park	36	42	46
Averages	34	35	34
West and S.W. Districts:			
Ravenscourt Park	69	106	105
Westminster	28	24	23
South Kensington	25	27	27
Kew Observatory (S.)	28	21	19
Wandsworth Common	20	22	24
Kew Observatory (N.)	22	19	17
Averages	32	36	36
Averages for all eleven stations	32·7	35·6	34·9

collected during the past three years by the London gauges, the results being expressed as tons SO_3 per square mile per annum, and the figures for the eleven stations being grouped, as in Table II. The results show that Ravenscourt Park is once again the worst district of London for sulphurous acid, the total collected being six times that found at Kew, and more than double that collected at Golden-lane. It is notable also that the averages for sulphur acids collected at the eleven observation stations is higher in the west and south-west districts of London than in the east and central districts, which is a very significant result of the observations. The general average of sulphur acid pollution of all the eleven stations is 34·9 tons, and shows only a slight decline upon the average of the previous year, which was 35·6 tons. If the figures from the two new stations at Horsferry-road and at Mount-street are included in the general average for 1931–32 the figures are practically the same for both years.

SULPHUR POLLUTION IN OTHER TOWNS.

In order to see how the London results for sulphur impurity compare with those obtained in other towns and cities, some typical figures have been collected in Table IV., showing the amount of sulphur acids

TABLE IV.—*Comparative Amounts of Sulphur Collected in Ten Towns and Cities of the United Kingdom during the Three Years ending March 31st, 1932, Expressed as Tons of SO_3 per Square Mile per Annum.*

Town or city.	1929–30.	1930–31.	1931–32.
Bourneville	13·3	14·0	12·2
Southport	17·4	16·4	12·6
Birmingham (Central)	43·8	48·3	27·2
Glasgow (average nine stations)	41·2	39·1	37·0
Leeds (Park-square)	36·9	38·5	40·0
London (average of eight stations)	35·2	41·1	40·6
London (Golden Lane)	42·2	47·0	45·2
St. Helens	56·0	40·0	46·5
Liverpool (Netherfield-road)	65·2	68·8	71·2
London (Ravenscourt Park)	69·0	105·6	104·6

collected during the past three years in the gauges at various places. The two gauges installed at

Bourneville record the lowest figures for sulphur pollution—10·2 tons—while Southport comes close behind with a total of 12·6 tons. Central Birmingham shows the lowest sulphur impurity of the larger cities in 1931–32, namely, 27·2 tons; while Glasgow and Leeds show lower totals for sulphur than London in 1930–31 and 1931–32. The Netherfield-road district of Liverpool and the Ravenscourt district of London, it will be seen, occupy positions at the bottom of the table, with totals of 71·2 and 104·6 tons respectively.

Finally, the highest and lowest results in 1931–1932 for total solids and for sulphur acids have been collected in Table V. From these figures it is seen

TABLE V.—*Highest and Lowest Results in* 1931–32 *for Total Solids and for Sulphur Acids at Individual Stations.*

	Total solids.	Sulphur acids.
Highest results.		
Ashington (High Market)	739	64
Liverpool (Netherfield-road)	530	71
Burnley (Town Hall)	477	40
London (Ravenscourt Park)	472	105
Sheffield (Surrey-street)	343	33
Glasgow (Tollcross Park)	332	44
London (Golden-lane)	303	45
Lowest results.		
Southport (Hesketh Park)	96	10
Wakefield (Clarence Park)	105	15
Rothamsted	105	—
Marple	107	—
Bourneville Village	110	12
Gloucester	134	—

that the gauges located at High Market, Ashington, and at Netherfield-road, Liverpool, collected the largest amounts of solid matter during the twelve months ending March 31st last, while the Ravenscourt Park, London gauge, and that at Netherfield-road, Liverpool, collected the largest amount of sulphurous acid impurities.

The Southport (Hesketh Park) gauge, on the other hand, heads the list of lowest results, with 96 tons of solid impurity, and 10 tons of sulphur acids, while Clarence Park, Wakefield, and Rothamsted follow closely behind. When one considers that Southport is a town of 80,000 inhabitants, the position it occupies in these comparative returns of atmospheric pollution is very creditable to the residents and health authorities of the place. The municipal authorities of other towns would be wise to keep the Southport figures of air pollution before them, as an example of what can be achieved under present conditions by a very widespread adoption of gas and electricity for domestic heating purposes.

THE SALFORD (LANCS.) RESULTS.

The 1931 Annual Report of the Medical Officer of Health for Salford contains a section devoted to the atmospheric pollution observations carried on in that city, and Dr. Osborne states that excessive tar and excessive acidity are the chief features of Salford's atmospheric pollution, when compared with that of other districts. The following figures are given in confirmation of this observation, the results being expressed as tons of tar deposited per square mile per annum :—

Walsall	16·8
Salford (Regent-road)	13·2
London (Golden-lane)	7·3
Leeds (York-road)	4·3
Southport (Hesketh Park)	1·8
Southport (Marsh Side)	1·2

The tar deposit in the Regent-road district of Salford is therefore twice as great as in Golden-lane, London, and is eleven times greater than that observed in the Marsh Side district of Southport. Dr. Osborne ascribes the high tar contents of the impurities collected by the Salford gauge to the imperfect combustion of bituminous coal in hundreds of thousands of local domestic grates, and he adds that the common practice of "banking up" house fires with small coal in order to keep them burning slowly is responsible chiefly for the large volumes of tarry smoke which are discharged daily into the atmosphere in South-West Lancashire.

Special observations have also been carried out in the Salford area upon "atmospheric acidity," and the actual acidity of the collected rain water has been determined by two methods, namely, by direct titration with an alkali and by the determination of the p H value. The results show that Salford's rain water possesses a higher acidity than that of any other station where these observations have been made, and that this acidity was present in every month of the year. The following figures are given in support of this statement, the results being expressed as tons of sulphuric acid per square mile per annum :—

Salford (Regent-road)	24·0
Rochdale electricity works	17·7
Sheffield (Attercliffe)	14·9
London (Southwark Park)	2·5
London (Wandsworth Common)	1·1

The large amounts of acidity in the atmosphere of Salford and of other Lancashire towns is attributed to the burning of large quantities of Lancashire coal with a high-sulphur content, and Dr. Osborne states that this is undoubtedly a matter of concern, not only on account of the increased corrosion caused to metal and stone work, but on account of its bearing upon the health of the population. In his previous Annual Reports he has drawn attention to the relatively high bronchitis death-rate in Salford, and in the Manchester group of towns, and he states there is little doubt that atmospheric impurity is directly connected with bronchitis mortality.

It has been suggested recently that cancer of the lungs may be in the same way set up by atmospheric pollution, more particularly by the tarry constituents, and in order to discover to what extent statistics give support to this view the lung cancer mortality figures for the county boroughs of England and Wales for the ten-year period 1921 to 1930 have been obtained from the Registrar-General, and are published in this 1931 Salford Report. A preliminary study of the figures has not revealed such a close connection as that found to exist between the bronchitis death-rate and atmospheric impurity, but the figures indicated that generally speaking, seaside towns were more free from lung cancer, than inland towns, the relative figures being: coastal towns, 19·63 per million; and non-coastal towns, 26·31 per million.

Literature.

The Mechanics of Deformable Bodies. Being Vol. II. of "Introduction to Theoretical Physics." By Professor MAX PLANCK. Translated by Professor HENRY L. BROSE. London: MacMillan and Co., Ltd. Price 10s. 6d. net.

THIS volume is written in the true Planck tradition, and exhibits the stimulating qualities and gift of expression associated with the author's name. Throughout his publications, Professor Planck appears to be always less interested, from the physical point of view, in the general solution of the characteristic differential equation than in those particular solutions which are adapted to certain important processes in Nature. Vols. III., IV., and V. have already been published, and Vol. I., dealing with "General Mechanics," will appear shortly, and thereby complete the treatise. The author possesses outstanding qualifications for preparing these volumes, as he has devoted himself to the study of theoretical physics, and in particular to that of thermo-dynamics, and held with distinction the position of editor of "Annalen der Physik."

The present volume comprises the substance of Professor Planck's lectures at the Berlin University. In them the subject of the mechanics of deformable bodies is developed as an inherently necessary consequence of general mechanics, which forms an important link in the study of physical science from its elementary concepts to that of the most recent developments. The general laws of motion of continuously extended bodies are considered in the early sections of the book, leading on to a study of the applications of specific cases of motions associated with infinitely small deformations, and culminating in a discussion of finite deformations. The fundamental theories are traced and developed with as little mathematics as possible, and a substantially complete outline survey is given of the subject in a thoroughly systematic manner, and with the fine perception to be expected of the author, who sketches in the background with confidence and economy. The difficulties associated with the study of theoretical physics are very largely overcome by his convincing and lucid explanations of the various theories and the clear presentation of abstruse and complex ideas. The efficient work of the translator is much in evidence throughout the text of a brilliant study written in a most attractive style.

Discussing the laws of kinematics, the author commences by endeavouring to represent in mathematical terms, the properties of motions in themselves. The first example considers the general case of a linear change with a statement regarding its properties, and it is shown that all the material points which lie in one plane before the change, also lie in one plane after the change. The theorem of the conservation of planes leads directly to the theorem of the conservation of straight lines, and the conservation of the order of any surface, since the order number of a surface is established by the number of points in which it intersects a straight line. By means of a simple mathematical procedure, a method is given for calculating the change of volume of any parallelopiped cut out of a body, the parallelopiped being characterised by any four arbitrarily chosen corner points. The properties of a dilatation in three mutually perpendicular directions are considered, a clear explanation is given of how the general equations of a homogeneous linear change may be simplified, and an attempt is made to calculate the principal dilatation and the direction cosines by applying the general relationships between the direction cosines. Theorems which in general have a comparatively complicated physical significance are considered in detail. One of importance shows how that every infinitely small homogeneous transformation can be produced by means of a dilatation in the direction of the three co-ordinate axes and six shears of the planes parallel to the co-ordinate planes, the motion of the shears being in the direction of the axes. The relationships developed in this section by Professor Planck play an important *rôle* in the study of deformable bodies, and are of outstanding application in several other branches of physics.

The second part of this volume deals with the states of equilibrium of rigid bodies, and vibrations in rigid bodies, liquids, and gases. The general expression of the elastic potential is well developed and formulated, and from it are obtained the six pressure components as linear homogeneous functions of the deformation components, i.e., the existence of an elastic potential amounts to the same thing as the condition that, in the constants of elasticity a_{ij}, the two indices i and j may be interchanged. An ingenious method is adopted by the author for studying the twenty-one constants on which the elastic behaviour of a homogeneous crystal depends, and an expression is given for the elastic potential of a regular crystal, such as fluorspar or diamond, which still depends on three constants. Some of the theories developed are applied to statical problems involving isotopic rigid bodies. Cubical and linear elasticity and examples of torsion are considered, and a detailed study made of the torsion which a cylinder undergoes when it is of elliptical cross section and when its upper end face is on the same couple N, whilst the mantle is not acted upon by external forces. In studying the analytical representation of periodic functions, the author, after making a highly interesting digression into the domain of art and music, gives prominence to the representation of the vibration of a string in the form of singly periodic vibrations, which is not only of mathematical, but also of physical and physiological interest, on account of its importance in acoustics. Attention is directed to the remarkable fact that the ear essentially performs exactly the same as the mathematician when from a given function he calculates the individual components A_n and B_n of the corresponding Fourier series. Interesting speculations are made regarding the peculiar effects of chords of consonant intervals, and the problem how the trained ear may distinguish tones and qualities of individual instruments in the mass of sound produced by a combined choir and orchestra, and what physiological processes underlie the resolution of a musical sound into its partial tones. It appears that the sense of hearing carries out the same resolution of the sound wave as corresponds to the transformation of this wave into a sum of singly periodic waves, but that Nature makes use of the same method as mathematics.

The more general case of motions with finite deformations are dealt with in a final section of the volume. The initial use made of the equations of hydrodynamics is to apply and verify the principle of conservation of energy, which is followed by a consideration of the specific applications of the hydrodynamic laws, conditions of equilibrium, and the case of an incompressible fluid which rotates about an axis with uniform angular velocity. An important integration is given of the hydrodynamic equations, which have an importance in hydrodynamics similar to the principle of areas (law of sectional areas) for general mechanics. The laws of vortex motion are deduced, fluid motions are classified, the Laplace and Gauss equations are developed, leading on to a study of a simple example of a non-stationary irrotational motion of an incompressible fluid. Some reference is made to other classes of thermodynamic phenomena in Nature, whose laws are not in conformity with these differential equations.

In the matter of those features which are of particular interest to the mathematical physicist, the author has produced a work of high intrinsic value, which is distinguished by vision and begets increased confidence in its guidance as it develops. The volume is well produced, and the publishers are to be congratulated on the clear setting-out of the mathematical symbols.

BOOKS RECEIVED.

"Mechanical World" Electrical Pocket Book, 1933. London: Emmott and Co., Ltd., 28, Bedford-street, W.C.2. Price 1s. 6d. net.

Aeroplane Design. By R. Rodger. London: The Draughtsman Publishing Company, Ltd., 96, St. George's-square, S.W.1. Price 6s. net.

The Method of Dimensions. By A. W. Porter, D.Sc., F.R.S. London: Methuen and Co., Ltd., 36, Essex-street, W.C.2. Price 2s. 6d. net.

High-speed Diesel Engines. By A. W. Judge, A.R.C.Sc., &c. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C.2. Price 10s. 6d. net.

Spon's Engineers' Tables. Thirteenth edition. By J. T. Hurst. London: E. and F. N. Spon, Ltd., 57, Haymarket, S.W.1. Price 1s. 6d. net.

Rubber Latex. By H. P. Stevens, M.A., &c., and W. H. Stevens, A.R.C.Sc. London: Rubber Growers' Association, 2, Idol-lane, E.C.3. No price stated.

Continuous Frames of Reinforced Concrete. By H. Cross and N. D. Morgan. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C.2. Price 28s. net.

Economic Tables for Electrical Engineers. By D. J. Bolton, M.Sc. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C.2. Price 1s. 6d. net.

The Eclipse of British Sea Power: An Increasing Peril. By Sir Archibald Hurd. London: *The Shipping World*, Effingham House, Arundel-street, W.C.2. Price 2s. net.

Hoyer-Kreuter Technological Dictionary, Part III.: French-German-English. Edited by Dr. A. Schlomann. London: *Machinery*, 52–54, High Holborn, W.C.1. Price £5 10s. net.

Conduction of Electricity Through Glasses: Vol. II., Ionisation by Collision and the Gaseous Discharge. Third edition. By Sir J. J. Thomson, O.M., and G. P. Thomson, F.R.S. London: The Cambridge University Press, Fetter-lane, E.C.4. Price 30s. net.

Box Gate at Elderslie Dock.

As recorded in our Journal note of January 27th, the new graving dock constructed by Sir Robert McAlpine and Sons, for Barclay, Curle and Co., Ltd., at Elderslie, was formally opened on Thursday, January 19th, when the Blue Funnel liner "Ulysses" entered it for overhaul and painting before starting on Saturday last, February 11th, on a lengthy pleasure cruise. The dock has been built and equipped according to the instructions of Mr. A. C. Gardner, M. Inst. C.E., consulting engineer to Barclay, Curle and Co., Ltd. It has a length of 620ft., an entrance

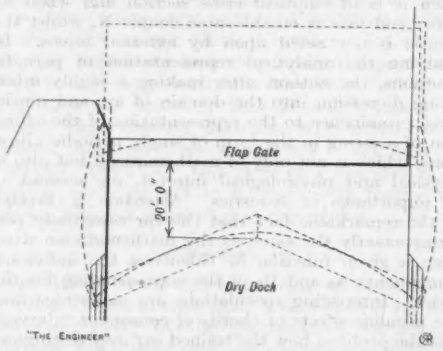


FIG. 5—SPACE REQUIRED TO OPEN "BOX" AND VERTICAL SWING GATES

width of 85ft., and a height from the sill to the cope level of 36ft. A special feature of the dock lay-out is the end gate, which is of the Box, or flap type, and was designed and built by Sir William Arrol and Co., Ltd., in Glasgow.

The "Box" gate, named after its inventor, Mr. Edward Box, M. Inst. C.E., of Newcastle, is a single-leaf gate with a hinge or keel running horizontally across the sill. It is lifted and lowered by means of two steel wire ropes, one made fast to each of its upper corners, the other ends of these ropes being attached to electrically-operated winches placed one on either side of the dock entrance

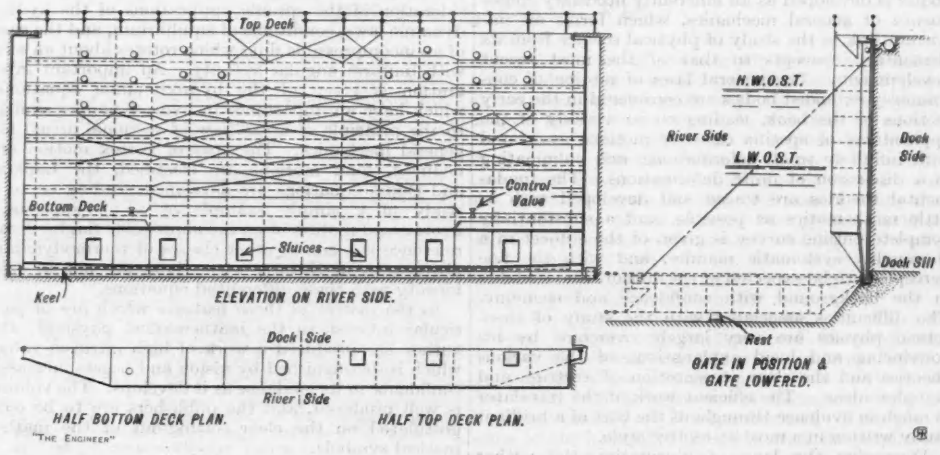


FIG. 6—BOX GATE FOR ELDERSLIE DOCK

at coping level. The gate is opened by being lowered through the water into a horizontal position, the ship passing over it into the dock. The action of the gate is clearly shown by the engravings Figs. 1 to 4, reproduced on page 170.

One of the main advantages in using a flap gate at Elderslie Dock, which is common to all gates of the "Box" type, was that the dock construction, including the entrance walls, could be reduced in length, while the available length for ships in dock was maintained, or, in other words, the gate could be placed nearer the river frontage than could be done with any other type of gate. The sketch, Fig. 5, illustrates this point. It will be noted that the "Box" gate can be placed 20ft. nearer the river than could vertical swing gates. The alternative, if double-leaf vertical swing gates had been adopted, would have been to extend the dock at the top end by 20ft. in order to obtain the same length for docking which is available by use of the "Box" gate. This would have added considerably to the cost of the work. Another saving was the elimination of the expensive hollow quoins which would have been necessary if ordinary swing gates had been used. Incidentally, the shortening of the dock obviated the removal of certain buildings in the shipyard, which would have added significantly to the cost of the scheme. A floating caisson was also considered, but owing to its width there was the same objection to it as to double-leaf gates. Further, owing to the flotation levels, a caisson could not be operated at a less depth of water than 21ft. on the sill.

The drawings, Fig. 6, and the engravings on page 170, clearly illustrate the design of the gate. It is of cellular construction, the outer skin plating extending from the top to the bottom edge of the lowest rib, and the inner plating from the top to bottom. The spaces between the ribs are subdivided by means of vertical bulkheads into a series of water-tight compartments. Under working conditions certain of the compartments act as buoyancy chambers for the purpose of reducing the stresses in the lifting and lowering gear, and also the weight of the gate on its hinge and on the rest supports. Water has access to the remaining compartments by means of openings in the skin plating and ribs, and is free to rise and fall with the tide. The gate is so balanced by means of the air and water tanks, and a certain amount of kentledge immediately above the keel, that the operating winches are only called upon to deal with a maximum pull of 20 tons on each rope when lifting or lowering the gate at low water.

The hinge or keel consists of cast iron semi-circular heel castings fixed into the dock sill. These castings were carefully machined in the workshop, and thereafter set at site with great accuracy. The gate keel is constructed of greenheart timber, and as this timber keel is kept in constant contact with the cast iron heel castings, it is not possible for *débris* of any kind to lodge anywhere in the gate hinge. With the type of gate described it will be noted that the pressure is uniform along the whole length of the keel or hinge. For raising and lowering the gate two operating winches are provided, the current being supplied at 400/440 volts, three-phase, 50 cycles.

Austin adjustable constant current electric gear forms a special feature of the electrical equipment. As well as operating the gate winches, the same gear is used for driving two electric capstans placed on the dock side which are shown in Fig. 8. With the Austin gear the operating motors on the gear winches and 7-ton electric capstans can be stalled under load without harm either to the electric motors or their control gear. The gear, in effect, has all the advantages of a hydraulic drive,

FIG. 7—DOCK AND 25-TON FITTING-OUT CRANE

and in the case of the winches, the pulls and speeds of the two ropes connected to the ends of the gate are equalised by the special characteristics of the motors.

After the gate was completed at the Bridgeworks of Sir William Arrol and Co., Ltd., Glasgow, it was transported in suitable units to the bottom of the new dry dock, in which position the parts were assembled. It was erected on its flat, and after completion the air chambers were all tested hydraulically, the greenheart at this stage being finally dressed. The dock was thereafter flooded and the gate, as shown in Fig. 1, page 170, floated into its position at the entrance.

By means of water ballast and temporary winches—the permanent winches not at this stage being ready to handle it—the gate was up-ended, as shown in engravings 2, 3, and 4, on page 170, the keel at a certain stage in the operations being guided into its final place in the cast iron sill plate. The dock was thereafter pumped out, the cofferdam at the dock entrance was withdrawn, and the earthwork dam at the entrance removed by a dredger.

A further feature of the "Box" gate is the ease with which, if necessary, it can be shipped out and into place. In order to unship it all that is needed is to close at low water the water ballast tidal chambers. When this has been done the gate becomes buoyant at high water, and floats out of the keel castings. By adding water ballast in certain compartments the gate can be floated over on to its flat and warped or towed out of the dock entrance in the horizontal position.

Engraving Fig. 7 shows the 25-ton fitting-out dockside crane, which is an important item of the equipment of the new dock. This crane is electrically driven in all its motions, and travels on bogie carriages. These carriages are fitted for the purpose of travelling the crane round a curved railway from the dockside to an adjoining fitting-out quay, so that it can be used either when a vessel is in the dock, or at the fitting-out quay. The crane can lift 25 tons at 74ft. radius and 10 tons at 100ft. radius.

The whole of the installation we have described, includ-

FIG. 8—GATE-OPERATING WINCH AND CAPSTAN

ing the Box gate, the gate-operating machinery, the electric capstans, and the 25-ton fitting-out crane, was manufactured and erected by Sir William Arrol and Co., Ltd.

The Design of Kilns for the Seasoning of Timber.

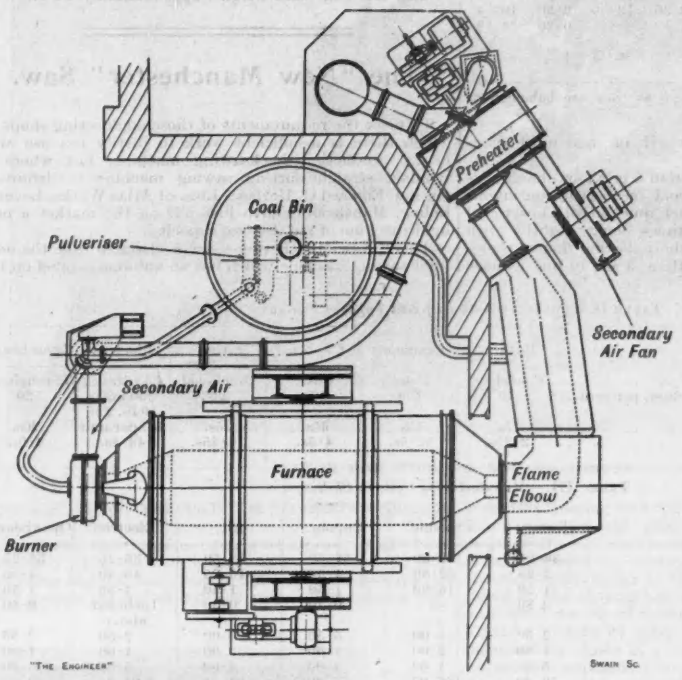
IN a lecture given before the Junior Institution of Engineers recently, by Mr. E. A. Steel (member), particulars were given of the processes and plant employed at the Forest Products Research Laboratory, Princes Risborough, described in THE ENGINEER of August 3rd, 1928, in connection with investigations into the seasoning of timber by artificial means.

Amongst the types of kiln used in the investigations are : (1) The internal fan kiln, where the circulation is created by a series of fans spaced on a common shaft in a basement arranged down the centre or sides of the kiln. Heating is by passing air over steam-heated coils and thence upwards through gratings or distributors, humidification by steam sprays outside the distributing duct. A certain quantity of fresh air drawn in and of air which has passed through the pile is expelled through controlled inlets in the side and exits in the roof. A feature of this type of kiln is the possibility of reversing the air flow. (2) The external fan kiln, where the fan and heating units are placed in a room adjoining the kiln, a centrifugal fan drawing hot air from the heating coils and forcing it along a duct connected to the distribution duct in the kiln, the wet air being withdrawn *vid* the heater and re-circulated. Humidification by steam jet in the heater. (3) The water spray kiln, in which the humidity is regulated by water sprays arranged in rows along one side of the kiln below the floor. Heating coils directly under the loading floor. Circulation upwards and through the pile then downwards under the action of the water sprays into a humidifying chamber and then to heating coils for re-circulation. (4) The overhead internal fan kiln, which avoids excavation under the kiln, the whole equipment is carried on a timber floor laid on steel joists spanning the width of the kiln. The fans and distributing gratings as in the first type, but arranged to deliver air downwards. The 1¼ H.P. motor drying fans bracketed on outside wall of kiln. (5) The natural draught kiln having no fans, therefore cheap, easy to install and operate, but much slower in action than fan kilns. Heating by coils in basement, humidification by small steam sprays projecting upwards in middle of central chimney between the piles. (6) The steam jet kiln, recently developed in the Laboratory as an improvement on the last type ; circulation by fine steam jets through ⅛ in. diameter nozzles blowing into injector cones placed at 2ft. intervals along the kiln ; the cones force the air across the basement of the kiln over heating coils, then up through a tapered duct formed by the kiln wall and the pile. The circulation of this kiln is twice as rapid as the natural draught and is much more positive in action, offering the advantage of a forced circulation without the expense of fans or motors ; it is intended to act as a "halfway" drier between the natural draught and the fan type of kiln.

Rotary Pulverised Fuel Furnace for Cast Iron.*

By P. M. MACNAIR, B.Sc., Ph.D.

CONSIDERABLE interest has been aroused in the foundry trade of recent years by the introduction of a new type of melting unit known as the rotary pulverised fuel-fired furnace, of which several different types on the market are known more widely by the name of the company or person associated with their development, such as the Brackelsberg, Sesci, Buess, and Sklenar. These, however, differ more in detail than in principle.



BRACKELSBERG ROTARY MELTING FURNACE

important step towards the smelter's ideal of a very hot flame, simple control of the furnace atmosphere to give the minimum oxidising conditions, quick response to alterations in feed, and a low fuel cost. Satisfactory results are obtained with a grinding fineness of 75 per cent. through a 200-mesh for bituminous coal and about 90 per cent. for anthracite. The coal dust is carried to the burner in a primary air stream which amounts to about 30 per cent. of the total air required on full load. The quantity is kept constant for all loads, and is so arranged as to be sufficient to carry the coal dust without deposition. This makes for ease of control of the flame, as the only regulation required is the coal feed and damper or motor control on the secondary air fan. It is not possible to preheat the primary air beyond about 350 deg. Cent. for bituminous or 450 deg. Cent. for anthracite coal, owing to the danger of ignition in the pipes before the coal reaches the burner. Any conveniently available preheat may be used in the secondary air, on which there is no limit. This arrangement of the double stream thus allows of the most efficient use of the preheated air, and also promotes the rapid ignition and combustion of the fuel when mixing occurs at the burner. Various designs of burner are in use, and this constitutes one of the main differences in the types of furnace. An important factor in the success of the rotary furnace is the ease with which a large heat release can be obtained. This is of the order of 100,000 B.Th.U. per cubic foot of furnace space per hour, which, by calculation, shows that combustion must be completed in a period of about half a second.

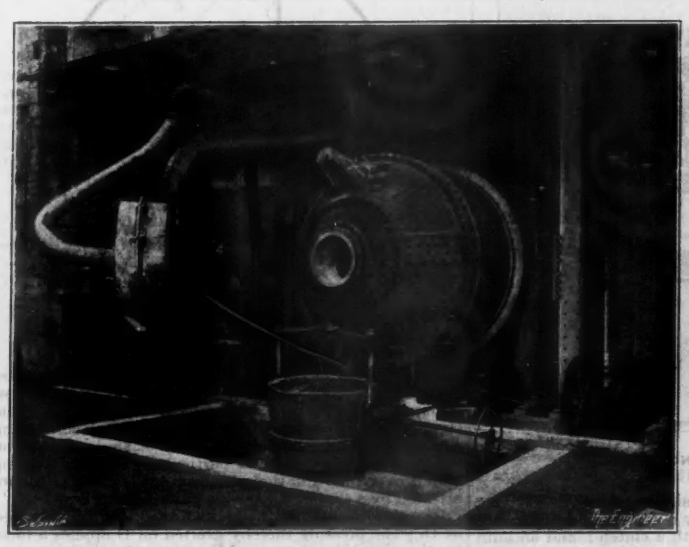
The coal is carried in a primary air stream and enters the burner through a central pipe having a swirling vane. The hot secondary air is given a similar swirl in the annular space just before meeting the primary stream at the burner nozzle. In this way a very turbulent flow is produced which ensures rapid mixing and combustion of the coal. The velocity of the incoming stream is greater than the rate of propagation of flame, so that the burner itself is always kept cold. In one installation, after forty heats the face of the cast iron burner was as whole as on the day it was first used.

The furnace proper consists of a cylindrical mild steel shell with cone-shaped ends. The refractory is tamped inside this shell with suitable rammers to a depth which is dependent on the furnace size. The usual material is a high-quality ground ganister, mixed with about 10 per cent. of a siliceous clay bonder in order to give a solid coherent lining. During operation the furnace is continuously rotated slowly at a speed of about one revolution in 1½ min. This causes the charge to be turned over during melting and exposes fresh surfaces to the flame. During the upper part of its travel the lining becomes superheated and gives up some of this heat to the charge by conduction, as it travels beneath. This action further prevents the excessive roof temperatures, with consequent troubles, which are common in many other types of smelting furnace. In addition, there is no permanent slag line, with its tendency to heavy corrosion at that level. The rotation causes steady and even mixing of the molten metal with no violent splitting of the slag and exposure to the furnace gases. In the tipping type the furnace is mounted so that it can be moved from the horizontal to the vertical position. This facilitates charging, which can be accomplished by means of a chute from an overhead platform. As the metal thus tends to collect at the bottom end, the front end is then lowered below the horizontal and the whole rotated, which distributes the charge evenly throughout the length. The tipping also ensures complete removal of all metal and slag from the previous charge and has additional advantages in speeding up re-lining without the necessity of powerful overhead cranes.

As most foundries work only during the daytime, it is necessary to have a metallic regenerator or recuperator in order to get rapid preheating of the air ; brickwork is too slow in its action. The usual type installed is a tubular recuperator with the cold air passing through the pipes and the hot gases circulating outside. An interesting development, however, is the Ljungström air preheater, which has the advantages of a true regenerator. A circular drum, packed with heat-resisting elements to give a large area, rotates about an axis so that the elements pass alternately from the hot waste gas flue to the cold air intake flue. During the passage in the waste gases the elements get heated up and subsequently give up their heat to the cold air. The usual figure of preheat is from 400 deg. to 500 deg. Cent.

METHOD OF OPERATION.

The furnace is always ready for melting work and can be put into operation at a moment's notice. The charge is run in, a wood fire lit at the entrance and the powdered fuel, with primary air only, started. The flame strikes immediately, even when the furnace has been lying idle for days and contains a cold charge. Secondary air is turned on, and the coal feed can be brought to a maximum within five or ten minutes. In about fifteen minutes the furnace is given a partial turn to expose fresh surfaces of cold metal and lining. This is repeated at two intervals of ten minutes and finally about thirty-five minutes after starting from cold the furnace is set in continuous rotation. The metal is rapidly melted and a protecting layer of slag formed on top. The time when the metal is just melted can be obtained in a rather interesting manner. While the charge is still solid the rotating motor takes about 3 ampères ; when the charge is almost melted the motor wavers and finally drops to a steady value of 2 ampères when the charge is completely molten. When experience has indicated that the metal is about ready, a spoon sample can be withdrawn to test for fluidity and quality. Any correcting or alloying additions can now be added, and these quickly incorporate themselves with the remainder of the melt. Rotation of the furnace is stopped with the



FURNACE WITH BURNER SWUNG ASIDE

FURNACE TIPPED UP FOR CHARGING

The essential parts of one plant are shown in Fig. 1 and may be summarised as :—

1. A pulveriser of the unit or central system type, in which the coal is reduced to a fine dust.
2. A burner, where the dust and air for combustion mix to generate a hot flame inside the furnace proper.
3. A cylindrical rotating furnace, in which the charge is melted. This may be made tipping or non-tipping.
4. A regenerator, where the combustion air is preheated by waste gases.

The use of pulverised coal with preheated air is an

* The Institution of Engineers and Shipbuilders in Scotland, February 14th, 1933. Abstract.

taphole well above the slag line, and a hole knocked through. By a further rotation the metal is run out into waiting ladles and distributed to the foundry. If for any reason all the metal is not required immediately, it is a simple matter to rotate the hole above the slag line again and hold the metal for any length of time until again required.

When using the furnace hot from a previous charge it is possible to start off on full coal feed with continuous rotation. Melting times are much quicker with lower coal consumption. The melting times vary slightly with different sizes of furnace, but the following figures represent approximate practice with a 5 or 10-ton furnace

TABLE I.—*Material Costs.*

	Price.	Rotary.		Cupola.	
		Quantity.	Cost.	Quantity.	Cost.
	s.	Tons.	s. d.	Tons.	s. d.
Borings ex shop	20	0·05	1 0	Nil	—
Foundry returns	—	0·30	—	0·30	—
Cast iron scrap	45	0·35	15 9	0·20	9 0
No. 3 pig iron	65	0·30	19 6	0·30	19 4
Refined pig iron	120	—	—	0·20	24 0
Material cost per ton charged	—	1	36 3	1	52 6

Foundry returns are not charged, as they are balanced in Table III.

TABLE II.—*Fuel Costs with Different Types of Furnace.*

	Rotary.	Crucible.	Cupola.	Air.	Electric.	Open hearth
Nature of fuel	Coal slack	Coke	Coke	Good coal	Electrodes	Throughcoal
Quantity used per ton of metal melted, per cent.	15	150	12½	65	500 units 10 lb. £80	20
Price per ton	15s.	35s.	35s.	25s.	1d. per unit	20s.
Cost of fuel per ton melted	2·25s.	52·5s.	4·5s.	16·25s.	48·8s.	4·0s.

TABLE III.—*Manufacturing Costs in Shillings.*

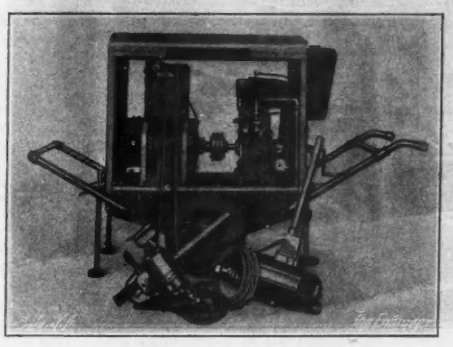
	Rotary.	Crucible.	Cupola.	Air.	Electric.	Openhearth.
Material	36·25	52·50	52·50	52·50	36·25	36·25
Fuel	2·25	52·50	4·50	16·25	48·80	4·00
Refractory	1·50	15·00	1·50	1·50	1·50	1·50
Power	0·80	—	0·30	0·30	Included above	0·30
Labour	2·50	5·00	3·50	5·00	2·50	2·50
Maintenance	1·00	2·00	1·00	2·00	1·00	1·00
Interest and depreciation	5·00	1·00	1·00	4·00	5·00	5·00
Total cost per ton of metal melted	49·30	128·00	64·30	81·55	95·05	50·55
Output in tons—						
Loss melting	0·01	0·01	0·06	0·02	0·01	0·01
Foundry returns	0·30	0·30	0·30	0·30	0·30	0·30
Good castings	0·69	0·69	0·64	0·68	0·69	0·69
Total cost per ton of good castings	71·5	185·5	100·5	120·0	138·0	73·0

tapping metal at from 1450 deg. to 1500 deg. Cent. From a furnace which has been lying idle for days, charged with cold metal and no preheat given, the first charge is out in from 2½ to 3 hours. A furnace lying idle from the previous day is tapped in 2¼ to 2½ hours, while subsequent taps from a hot furnace are ready in 1¾ to 2 hours.

Owing to the great variety of iron made and the wide range of efficiency found in various plants, it is not a simple matter to get out a comparative cost sheet which would be truly representative, but the annexed tables have been drawn up rather as an indication of the possibilities and are based on as nearly average practice as possible.

Portable Electric Generator.

IN collaboration with railway engineers, the small 1·5-kW portable electric generator, illustrated by the accompanying engraving, has been designed by B.E.N. Patents, Ltd., of Tottenham Court-road, London, for permanent way work. The engine and generator, plainly to be seen in the illustration, which shows the set with its



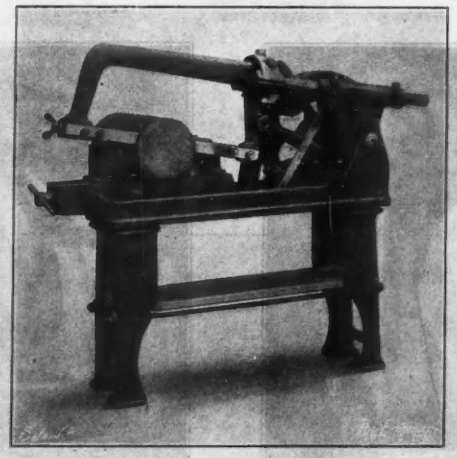
1½ kW PORTABLE ELECTRIC GENERATOR

side covers removed, are direct coupled by an insulated flexible coupling disc. Running at 1600 r.p.m., the single-cylinder engine has an output of 3·1 B.H.P. at a consumption of 0·75 pint of petrol per B.H.P. hour. It is air cooled, runs on the four-stroke cycle and has a bore of 3in. and a stroke of 3½in. The dynamo is fitted with interpoles, and, built specially for work of this nature, has considerable overload capacity. As can be observed in the engraving, the two units are mounted on a deep-section channel base, itself carried on a steel roller. This roller is made in three sections so that, owing to the differential action, the set may be easily turned or swung into any required position even when situated on the ballast of a railway track. Three adjustable sprags are fitted to the unit, two at the dynamo and one at the engine end. These may be lowered when the set has been placed in the desired position and allow the machine to be set level regardless of the unevenness of the surface on which it is standing. Reference has already been made to the side covers, and it remains to mention that they may be locked in position when the set is not in use, thus giving the machinery complete protection from the weather. At the same time, this lock prevents the machine being moved. All the controls, cable outlets, and fuses are arranged on the near side of the machine, and considerable attention has been directed in its design to accessibility. Where the conditions warrant the alteration pneumatic-tired wheels may be fitted instead of the roller. The overall dimensions of the set are as follows :—Length, 6ft.; width, 1ft. 10in.; height, 3ft. 8in.; and weight, approximately 4 cwt.

The "New Manchester" Saw.

To meet the requirements of those engineering shops in which there is insufficient work to justify the use of a heavy production hacksawing machine, but where a reliable, straight-cutting sawing machine is definitely needed, Edward G. Herbert, Ltd., of Atlas Works, Levenshulme, Manchester, have just put on the market a new light machine of 6in. by 6in. capacity.

This "New Manchester saw is claimed to be the only light sawing machine which has an automatic relief on the return stroke by means of an adjustable oil dashpot. Further, the "cutting on a corner" method first patented for and subsequently developed on machines made by the firm obviates the use of weights. A T-slotted table 18in. long by 4in. wide is cast in one piece with the bed of the machine, and a strong screw vice with swivelling jaws enabling 4in. stock to be mitred at 45 deg. is supplied as standard. Another interesting detail of the machine is the provision of two parallel square steel slide bars placed diagonally in the slides to secure self-alignment, thus materially assisting in maintaining rigid guidance of the

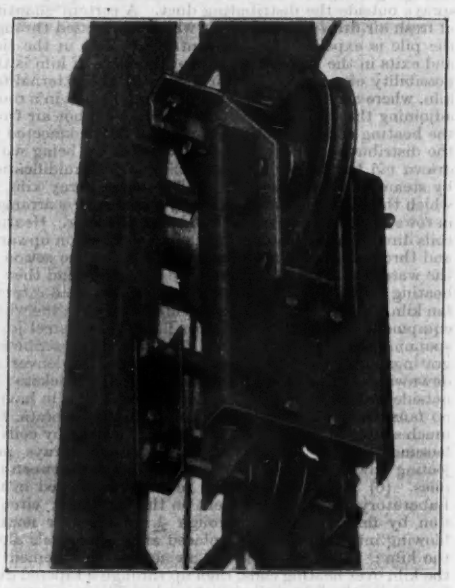


6 IN. × 6 IN. SAWING MACHINE

saw frame and consequent straight cutting over a long period of time. The drive is by a single pulley 14in. diameter and 2½in. wide, fitted with a clutch; and an automatic knock-off is provided at the finish of the cut. The main bearing is phosphor-bronze and of ample length, the crank shaft is 1¼in. wide diameter, and the crank pin and frame pin are hardened and ground. A tool shelf is provided in the base of the machine. This machine is designed to run at 100 r.p.m. and utilises 14in. blades. Its net weight is 280 lb.

Safe Load Indicator for Cranes.

THE latest type of safe-load indicator for cranes to be brought to our notice is the "Wylie" indicator, supplied by Butters Brothers and Co., of Glasgow and London, and illustrated herewith. On steam, petrol or hand cranes this device operates a semaphore. When normal loads are being handled the semaphore stands at safety. It moves decisively to the warning position when the limit of safety is approached, and when that limit is reached it moves to the danger position and, at the same time, a bell is rung or a whistle blown. On an electrically driven crane the semaphore may be replaced by a system of light signals, a green light corresponding to the safety position of the semaphore and a red light to the warning position. In this arrangement the red light, combined with the ringing of a bell, indicates that the limit of the safety range has been reached. In either case the signals do not distract the driver's attention by moving or changing until the corresponding signal loads are reached, when full movement or change takes place almost instantaneously. Another feature of the device is the fact that if a heavy load is "snatched" in such a way as to cause momentary overloading, the indicator flashes a warning and then immediately returns to the position appropriate to the dead load on the crane.



THE "WYLIE" CRANE LOAD INDICATOR

The indicator is operated by the lifting rope at the point where it bends round the mast pulley B. This pulley is mounted on a bracket C hinged to the crane mast at A, and prevented from turning upwards by the projection K. A lever E is hinged to the bracket C and carries a deflector pulley D over which the lifting rope is led. The lever E also carries a stop J and a cross bar F. This cross bar is strutted from the shaft of the pulley B by a "sensitive element" S U, consisting of two piles of steel plates, one on each side of the pulley B. The piles resemble laminated springs loaded endwise instead of transversely. They are stayed to each other at their mid points, and the plates composing them are formed with a small initial bend. The piles, it is stated, do not bend beyond the initial amount until the load on their ends reaches a first particular value. When the load attains this value the piles would continue to bend but for a stop comprising a precompressed spiral spring. When the end load on the piles reaches a second particular value, this spring stop is overcome and the piles bend farther until they are arrested by a second stop.

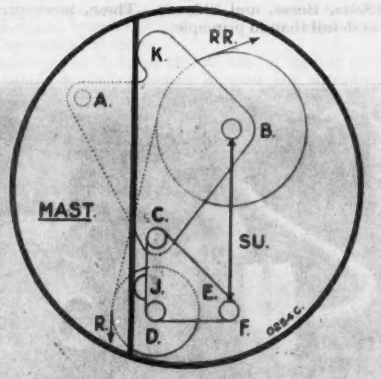


DIAGRAM OF INDICATOR MECHANISM

The vertical lead R of the lift rope is slightly deflected at D. The pressure thereby exerted on D applies a force to the sensitive element S U, proportional in amount to the tension in the rope. Within the range of constant maximum load the device rests on the projection K. The force on the sensitive element is, therefore, solely applied by the force transmitted to it from the rope through the pulley D, and is, therefore, proportional to the load on the crane hook. Beyond the maximum load radius the diminishing inclination of the inclined lead R R of the lifting rope acts to tilt the bracket C forward about A until the movement brings the stop J into action. This stop being on the lever E reacts and applies a force to the sensitive element additional to that applied through the pulley D. Hence, beyond the maximum load radius the load on the hook required to operate the signals diminishes as the lead R R swings downwards. The rate at which the load diminishes is governed by the position of the stop J on the lever E.

It is pointed out that the endurance of the device is

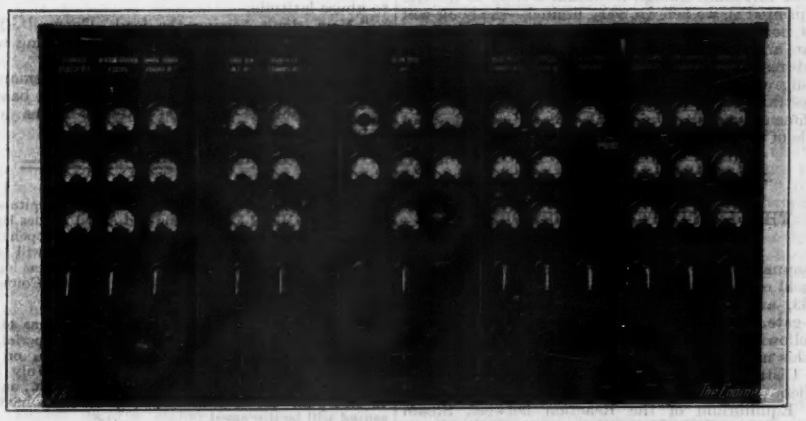
ensured by the fact that the parts do not move except when the load on the crane is near the margin of the safe working field. It is also claimed that the friction of the rope and pulleys is arranged to assist the signal to sound when the crane is working towards danger, and to stop it from sounding when the crane is working away from danger. In this manner the way to safety is at once distinguished from the way to danger.

New Mechanical Lead Joint.

A JOINT which, it is anticipated, will take the place of the ordinary lead joint for general gas and water distribution purposes has been introduced by the Stanton Ironworks Company, Ltd. The joint in question follows the design of the Stanton-Wilson self-adjusting joint, but in place of a rubber ring, protected with a lead tip, which is used for all purposes where extreme flexibility is required, the ring consists of an all-lead ring with a thin metallic cylinder encased and hermetically sealed within it. The Stanton mechanical lead joint can, it is claimed, be made without skilled jointers; is no more costly than the ordinary run lead or caulked lead wool joint when laid; possesses a degree of flexibility greater than that obtainable with the ordinary lead joint; is mechanically held in position when once made; and allows of no drawing of the lead joint, although the spigot end of the pipe is free to expand or contract. The company recommends that where a substantial movement between adjacent pipes has to be met, the Stanton-Wilson self-adjusting joint be used; and where the nature of the ground at present admits of the use of ordinary lead joints, that the Stanton mechanical lead joint be adopted. This joint will be put on the market for use with the Stanton-De Lavaud spun pipe, in sizes up to 20in. diameter.

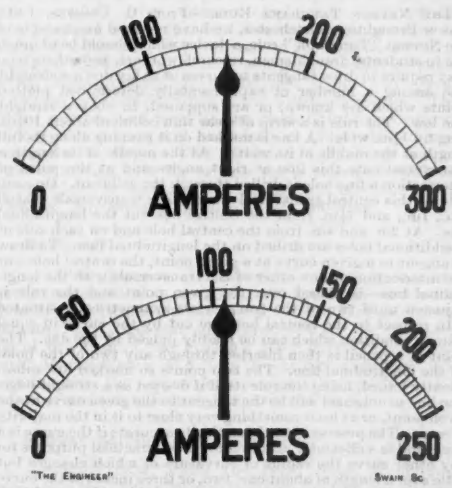
New Electrical Instruments.

WITH a view to saving space on modern control switchboards, the Metropolitan-Vickers Electrical Company, of Trafford Park, Manchester, has developed a range of small case switchboard instruments. Realising that the smaller the area within which the necessary indicating



SWITCHBOARD WITH SMALL CASE INSTRUMENTS

instruments and control switches can be grouped the easier is it for control engineers to discharge their duties, switchboard designers are now adopting the practice of mounting protective relays on separate boards and the introduction of these new instruments marks another step in the desired direction. The first illustration shows



INSTRUMENT SCALES

five panels of a nine-panel switchboard, equipped with these new meters, the complete board being designed to control a 30,000-kW turbo-alternator, three 4500-kVA and one 3000-kVA transformers, two 1500-kW motor generators, three bus-bar switches, and nine feeders. The overall width of each panel is 17in., or 15½in. between the headings. The instruments each have a dial 3½in. in diameter, an external diameter of 4½in., and a scale 4in. long. All the working parts are constructed on the same high-grade lines as those of the makers' 8in. instruments, and all the instruments, except those of the D.C. moving iron pattern, which are liable to additional errors of about 1 per cent., comply with the British Standard Specification for Grade 1 instruments.

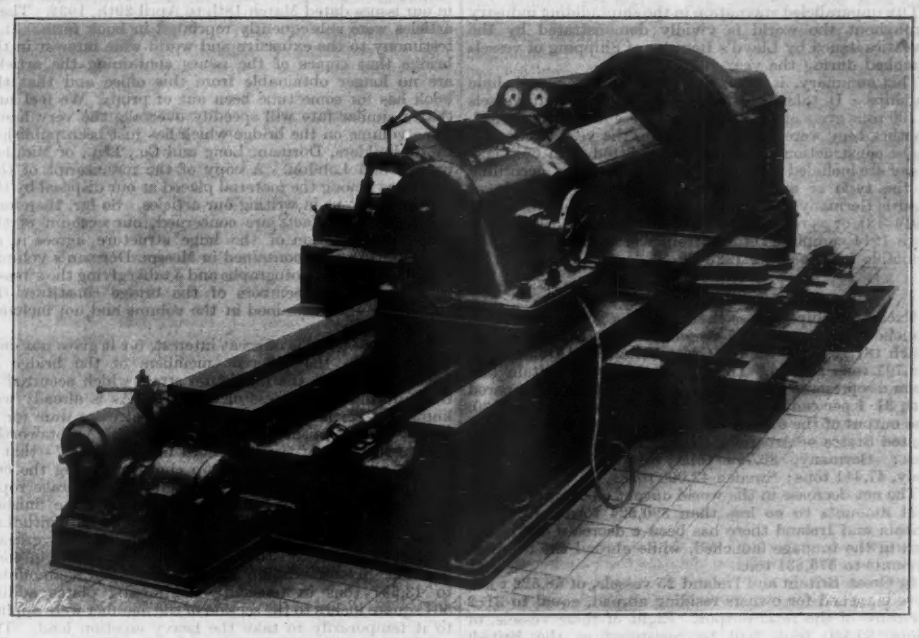
Standard meters are spring-controlled, and have externally operated zero adjusters, but all moving iron ammeters and voltmeters up to 250 volts may be supplied with gravity control at reduced price. Very strong permanent magnets are said to avoid difficulties due to strong feeds. The instruments are supplied in cases composed of black moulded bakelite, which reduces eddy current losses to a negligible amount, so that A.C. instruments may be used on circuits working at 50 cycles per second or more. The instruments may be of the flush pattern, as illustrated, or of the projecting pattern. As shown in the second illustration, the scales are boldly marked, and the position of the pointer can be seen from a distance of from 30ft. to 40ft. The new range of instruments includes moving coil ammeters and voltmeters for D.C. circuits, moving iron ammeters and voltmeters for A.C. or D.C. circuits, power factor meters, indicating wattmeters, reactive kVA meters, frequency meters, synchroscopes, and integrating watt-hour meters for single-phase and polyphase circuits. Ammeters are supplied as single-range or multi-range instruments. Many of the instruments can also be supplied in a strong desk-pattern teak case for test and laboratory purposes.

Ingot Turning Lathe.

IN order to remove the outer skin from square ingots of alloy or other steels, and thereby to ensure that all surface defects are avoided before rolling operations are begun, a lathe has recently been constructed by Craven Brothers (Manchester), Ltd., Reddish, Stockport, of which we give an illustration herewith. The machine weighs approximately 30 tons, and is capable of dealing with ingots up to 21in. square, and of a maximum overall length of 6ft. 8in., either taper or parallel, with straight, concave, or convex sides.

The bed is so designed that the cuttings fall clear at the back, the brackets for the copying bar which gives the required taper to the ingot being mounted at the rear. The fast headstock is of the totally enclosed type with positively lubricated gearing and a spindle running in parallel capped bearings, end thrust being taken on a ball thrust washer. Special gripping jaws are fitted on the face plate for holding the square header of the ingot, and the face plate is driven through eight changes of gear by a constant speed motor, the final reduction being through a forged helical gear ring secured to the rear of the face plate.

The loose headstock is traversed along the bed by a hand-operated screw and the barrel is adjustable by



LATHE FOR TURNING SQUARE INGOTS

reduction gearing and hand-operated screw. The saddle has a raised narrow guide, slides on the front and rear ways of the bed and carries two transverse rocking tool slides actuated by heavy cam motions which impart the rectangular shape to the ingot, while the taper is produced by the copying bar referred to above. All the gears and cams run in oil baths, while the tool slides have a separate system of lubrication. Feed to the saddle is imparted by means of a screw of large diameter actuated by ratchet mechanism with eight changes. The turning tools are carried in swivelling holders and rock above and below the horizontal to the extent required to retain constant clearance angle as the ingot revolves. Quick-power traverse is provided to the saddle by a small motor driving through gearing from the end of the bed. Push-button control from stations on the fast headstock and saddle, and "one-shot" lubrication are features worthy of mention.

TECHNOCRACY.

IN an address which was delivered at the annual dinner meeting of the Rochester N.Y., Chamber of Commerce, on January 16th, Mr. Van Deventer, editor of the *Iron Age*, put Technocracy under the white light of searching inquiry and common sense. He exploded the Technocratic claim that current unemployment has been caused by the machine, that "energy certificates" would abolish the price system and that technological dictatorship would usher in a four-hour day and a 20,000-dollar income. Human inertia cannot be banished by fiat, he declared, and Technocratic paternalism, like other forms of paternalism, would result in a sharp falling off in individual effort and efficiency. At the same time Technocracy would require a huge and costly bureaucracy for the detailed planning and supervision of the daily affairs of 125 millions of people, for checking up on the performance of assigned tasks, and for keeping account of individual inputs and outputs making up the energy budget. Such a chimerical "plan" implies a complete parting of the ways with the past. It implies a revolutionary experiment on a grand scale with no precedents to warrant hope of success. The premises of Technocracy are wrong, said Mr. Van Deventer. The machine is not to blame for the depression. Nor is the price system to blame. The fault lies with the heavy burdens that were imposed on the machine—over-capitalisation, graft, government intrusion in business and mounting taxation, not to mention securities speculation, which transformed the stock market into "the most stupendous gambling hell" in history.

THE South African Railways' report for the year ended March 31st, 1932, shows that, when compared with 1930–31 there was a decrease of 9·38 per cent. in the receipts, but expenditure was reduced by 8·83 per cent. The goods traffic decreased 11·37 per cent. in tonnage, and 18·71 per cent. in ton-mileage, and coal traffic fell 13·79 per cent. in tonnage, and 18·49 per cent. in ton-mileage. A considerable reduction in the maize traffic for export was largely responsible for the decreased goods traffic, whilst the less coal traffic was owing to a falling-off in the amount carried to the coast for shipment. The ratio of expenditure to earnings, exclusive of depreciation, was 70·90 per cent., as compared with 71·63 and 72·67 per cent. for the previous two years. The cost of working, exclusive of renewals, per average open mile, fell from £1339 in 1930–31, to £1189 in 1931–32. That result was mainly the outcome of economies, in staff conditions, and of the curtailment and reorganisation of train services, combined with improved and more economical methods of working. Maintenance of permanent way and works was reduced by 6·18 per cent., maintenance of rolling stock by 14·53 per cent., and running expenses by 11·50 per cent.

Lloyd's Register of Shipping.

ANNUAL SUMMARY.

THE unparalleled stagnation in the shipbuilding industry throughout the world is vividly demonstrated by the statistics issued by Lloyd's Register of Shipping of vessels launched during the year 1932.

This summary, it may be recorded, does not include warships. It takes into account only merchant vessels of 100 tons gross and upwards that were launched in 1932, whether they were completed during the year or are still under construction. Sailing vessels fitted with auxiliary power are included with steamers or motor ships, according to the type of engine. Returns are not available as regards Germany and Austria-Hungary for the war period (1914–18), or as regards Germany for 1919 and 1920, while since 1914 complete returns from Russia have only been available for the years 1926–29.

PARTICULARS OF OUTPUT.

Excluding ships of less than 100 tons gross, there were launched in the world 307 vessels of 726,591 tons gross, of which 187,794 tons were in Great Britain and Ireland and 538,797 tons abroad. The output in Great Britain and Ireland represents 25·8 per cent. of the total, as compared with 31·1 per cent. for 1931 and 51·2 per cent. for 1930. The output of the other leading countries is as follows:—United States of America, 143,559 tons; France, 89,310 tons; Germany, 80,799 tons; Japan, 54,422 tons; Italy, 47,441 tons; Sweden 43,000 tons.

The net decrease in the world output as compared with 1931 amounts to no less than 890,524 tons. In Great Britain and Ireland there has been a decrease of 314,693 tons in the tonnage launched, while abroad the decrease amounts to 575,831 tons.

In Great Britain and Ireland 25 vessels, of 58,522 tons, were launched for owners residing abroad, equal to 31·2 per cent. of the total output. Eight of these vessels, of about 35,500 tons, will be registered in the British Dominions overseas, and 6, of about 17,000 tons, are intended for France.

The world launches for the year include 35 vessels of over 6000 tons each, of which 12 are of between 10,000 and 15,000 tons, and 5 of 15,000 tons and upwards. The following are the largest vessels launched during 1932:—Great Britain and Ireland, quadruple-screw turbo electric ship, "Queen of Bermuda," 22,500 tons; France, quadruple screw turbo-electric ship, "Normandie," 68,000 tons; Italy, quadruple-screw motor ship, "Oceania," 20,000 tons; United States of America, turbine s.s., "Washington," 25,000 tons; turbine s.s., "Lurline," 18,021 tons.

The tonnage of new vessels which will be propelled by means of internal combustion engines amounts to about 269,000 tons (2443 tons in Great Britain and Ireland). In Great Britain and Ireland motor ships amount to only 1·3 per cent. of the mechanically propelled tonnage launched during 1932; abroad such percentage reaches 49·5.

During the year there were launched 19 vessels of about 148,000 tons, which are to be fitted with steam turbines, 4 other vessels of 104,000 tons for which the turbo-electric system has been adopted, and 6 vessels of about 22,500 tons with a combination of reciprocating steam engines and low-pressure turbines.

In Great Britain and Ireland there were launched 4 turbine vessels of 9571 tons, one turbo-electric vessel of 22,500 tons, and 1 vessel of 5739 tons with a combination of reciprocating engines and steam turbines.

During the year 16 tankers, of 134,629 tons, were launched, of which 3, of 5716 tons, were built in Great Britain and Ireland. Of these 16 tankers, 13 of 128,913 tons are motor ships.

It is to be noted that of the steam tonnage launched in the world—455,597 tons—about 285,000 tons refer to steamers fitted to burn oil fuel under the boilers, so that of the world tonnage (726,591 tons) launched during 1932, approximately 23 per cent. is exclusively dependent on coal for propulsion.

PROGRESS OF SHIPBUILDING DURING THE YEAR.

Lloyd's Register Quarterly Returns show that at the opening of the year 1932, 1,403,795 tons were being built throughout the world. Since then a further large decrease has taken place, the figures for the end of December being 765,720 tons, thus showing a reduction of 638,075 tons, as compared with December, 1931, of which the major portion (463,000 tons) has occurred in countries abroad.

At the beginning of 1933 only two countries had more than 100,000 tons of shipping under construction, viz.:—Great Britain and Ireland, 225,497 tons; and France, 101,675 tons. Next in order were:—Germany, 80,310 tons; Japan, 63,345 tons; United States of America, 59,628 tons; Italy, 59,113 tons; and Sweden, 58,530 tons.

In view of the present figures of tonnage under construction, and taking into account the fact that the amount of tonnage laid down during 1932, as shown in Lloyd's Register Quarterly Returns, has been considerably less than half sufficient to fill the place of the vessels launched during the year, the serious position of the shipbuilding industry throughout the world is at once manifest. The figures show, moreover, that the depression which has borne so hardly upon shipbuilders in Great Britain and Ireland is now being increasingly experienced by the industry as a whole in other countries.

VESSELS CLASSED BY LLOYD'S REGISTER.

Of the merchant vessels launched during 1932, 100, of 325,693 tons (65 vessels of 148,630 tons in Great Britain and Ireland and 35 of 177,063 tons abroad), were being built under the survey of the Society with a view to classification in Lloyd's Register Book.

Attention may be drawn to the figures showing the tonnage of new vessels classed by Lloyd's Register during each calendar year for the last thirty-four years. A remarkable feature disclosed by these figures is that the average yearly tonnage of new vessels classed by the Society for that long period (1899–1932) amounts to 1,608,256 tons, and that, despite the prevailing depression, the mean for the last five years is within 100,000 tons of that figure.

SYDNEY HARBOUR BRIDGE.

OUR readers will doubtlessly recall the series of seven articles on Sydney Harbour Bridge which we published in our issues dated March 18th to April 29th, 1932. These articles were subsequently reprinted in book form. It is testimony to the extensive and world-wide interest in the bridge that copies of the issues containing the articles are no longer obtainable from this office and that the book has for some time been out of print. We feel sure that a similar fate will speedily overtake the very handsome volume on the bridge which has just been published by its builders, Dorman, Long and Co., Ltd., of Middlesbrough and London. A copy of the manuscript of this book was among the material placed at our disposal by the firm to assist us in writing our articles. So far, therefore, as the material facts are concerned, our account of the design and erection of the huge structure agrees in all respects with that contained in Messrs. Dorman's volume. Some additional photographs and a table giving the stresses in the principal members of the bridge constitute the principal items contained in the volume and not included in our articles.

The stress table is of great interest, for it gives not only the stress in the different members of the bridge as finished, but also the maximum stress which occurred in them during the process of erection. As is already well known, at certain points the erection stresses were far in excess of the finished structure stresses. A noteworthy instance is that of the top chord member 29–27—that is to say, that portion of the top chord adjoining the end posts from the upper ends of which the anchorage ropes were led to the rope tunnel on shore. In the finished condition the dead load, live load, wind load, longitudinal force, and temperature effect represented an aggregate load of 1035 tons on this member and placed it in compression. The maximum erection load upon it amounted to 13,697 tons in tension. Reinforcing plates adding 504 square inches to the section of the member were applied to it temporarily to take the heavy erection load. The succeeding members of the top chord exhibited a similar but gradually decreasing difference between the erection and the finished condition loads until the eighth panel out from the shore was reached, from which point onwards to the middle of the span the erection stresses in the top chord members were less than the finished condition stresses. In the members of the lower chord the erection and the finished condition stresses were closely equal throughout and in every instance were of the same sign, namely, compressive.

By those fortunate enough to obtain a copy of it—the number printed is, we believe, very limited—the book will be prized, not only for the technical interest of its contents, but as an artistic production of high and lasting merit. It is in all respects a fitting literary tribute to a very great engineering work and is all the more acceptable because of the restraint of its language and the absence of any embellishment, verbal or pictorial, not strictly essential to the tale of technical achievement which it recounts.

THE INSTITUTE OF METALS.

THE annual general meeting of the Institute of Metals will be held on Wednesday and Thursday, March 8th and 9th, 1933, at the Institution of Mechanical Engineers, Storey's-gate, St. James's Park, Westminster, S.W.1.

The following papers have been selected for presentation at this meeting:—

"The Distribution of Porosity in Copper Ingots," Mr. N. P. Allen.

"The Equilibrium of the Reaction between Steam and Molten Copper," Mr. N. P. Allen and Mr. T. Hewitt.

"An Investigation of the Effects of Hydrogen and Oxygen on the Unsoundness of the Copper-Nickel Alloys," Mr. N. P. Allen and Mr. A. C. Street.

"An X-ray Investigation of the Copper-Aluminium Alloys," Dr. A. J. Bradley and Dr. Phyllis Jones.

"Graphitic Silicon: Heat Treatment and the Electrical Conductivity of Aluminium," Dr. L. H. Callendar.

"The Physical Properties of Zinc at Various Stages of Cold Rolling," Mr. R. Chadwick.

"The Application of the Diamond Pyramid Indentation Test to Copper and Copper-rich Alloys in the Form of Thin Strip," Dr. Maurice Cook and Mr. E. C. Larke.

"The Fatigue-resisting Properties of Light Aluminium Alloys at Elevated Temperatures," Mr. J. M. Cuthbertson.

"The Electrical Conductivity of Aluminium Wire," Mr. A. J. Field and Mr. J. H. Dickin.

"Note on the Influence of Volatile Chlorides on Magnesium and on Copper," Mr. J. D. Grogan and Mr. T. H. Schofield.

"The Interpretation of the Tensile Test with special reference to Lead Alloys," Professor B. P. Haigh and Mr. B. Jones.

"Some Effects of the Addition of Tellurium to Lead," Mr. W. Singleton and Mr. B. Jones.

"Experiments on the Effects of Variations in Mould and Pouring Temperatures on the Macro and Micro-structures of Some Low Melting-point Metals and Alloys," Frances D. Weaver (Mrs. Harold Heywood).

The annual dinner will be held on the evening of Wednesday, March 8th, at 7 p.m. for 7.15 p.m., at the Trocadero, Piccadilly-circus, W.1.

The afternoon of Thursday will be devoted to a visit to the headquarters of the British Non-Ferrous Metals Research Association, the laboratories of which will be open for inspection. There will be on view exhibits to illustrate the progress and results of a number of the researches carried out for the Association in Government and University laboratories as well as in its own headquarters.

Silver Jubilee Autumn Meeting.—The council has accepted an invitation from the committee of the Institute's Birmingham local section to hold the Silver Jubilee Meeting of the Institute in Birmingham from Monday, September 18th, to Thursday, September 21st. It would appear to be particularly appropriate for this notable anniversary to be celebrated in Birmingham, as it was in that city that the Institute of Metals had its first office—in the Metallurgical Museum of the University—and held its first autumn meeting in 1908.

Annual May Lecture.—On Wednesday, May 10th, M. Albert M. Portevin, the distinguished French engineer and president of the Société des Ingénieurs Civils de France, will deliver the twenty-third annual May Lecture to the Institute of Metals. The subject of M. Portevin's discourse will be "Quenching and Tempering Phenomena in Alloys."

THE IDEAL FOREMAN.*

HAVING worked for about fifty foremen during my workshop travels, I should be a bit of an authority on their natures; at any rate, my experiences and observations have caused me to arrive at very definite conclusions regarding the qualifications of a good foreman. Let me try and portray the ideal foreman for an engineers' factory.

No foreman worthy of his salt would stand and watch his men at work. When he wants to know how a man is shaping, he will go and ask him, confident of getting a truthful reply. Nor would he meander through the shop a couple of minutes before the hooter goes, just as the chaps are preparing to make a dash for the clock. If he has their confidence, it will be only necessary to walk through the place occasionally to see that they are well supplied with work, and during his peregrinations, he will have a cheery word for each man, possibly passing a little innocuous badinage. If he has not secured their confidence, all the watching and bullying in the world will not make them work conscientiously for him!

So, then, the successful foreman must be a mechanic, cheery, and tactful, well mannered, with a good voice. He should never *order* a man to do anything. A man usually obeys an order with sullen submission; he accedes to a *request* with alacrity.

The cynic will probably say that such a foreman would lose control of the shop. If men were allowed to sing, whistle, and chat; if they were allowed to stop a few minutes before the hooter goes; if the foreman was too friendly, the men would tend to take things easy, and output would suffer. That is not *my* experience.

After all, it's a question of understanding the human factor. Workmen are human beings, entitled to be treated as such, not as mere cyphers. To gain the confidence and respect of the men, the foreman must have confidence in them, and treat them with respect, without loss of dignity. Men respond to such treatment. They are the first to remonstrate with one who shows a tendency to abuse latitude.

"Now, don't 'swing the lead,' George! Things are not too bad here. . . . Don't go and blinking well spoil a good shop!"

Most workmen appreciate the human foreman. Friction is reduced to a minimum, distrust is all but banished, and the net result is increased interest in the job, and a happy shop!

EXHIBITION OF MODELS.—The Sheffield Hospitals' Council is organising a Model Engineering and Allied Trades Exhibition in the Edmund-road Drill Hall, Sheffield. It will open on April 5th and close on April 12th, and a small charge will be made for admission. There will be trade stands as well as loan exhibits. Further particulars may be obtained from the Council at Westfield-terrace, Sheffield, 1.

WORLD PETROLEUM CONGRESS.—The sessions of the World Petroleum Congress will be held at the Imperial College of Science and Technology, South Kensington, on Thursday, July 20th; Friday, July 21st; Monday, July 24th; and Tuesday, July 25th, at 10.30 a.m. to 12.30 p.m., and 2.30 p.m. to 4.30 p.m. At these sessions papers which have been presented will be discussed.

FARADAY HOUSE OLD STUDENTS' ASSOCIATION.—The Faraday House Old Students' Association and Faraday House Rugby Club have arranged to hold a supper dance on Friday, February 24th, at the Hotel Russell, Russell-square, W.C.1, from 8 to 2. The price of a double ticket, including supper, is 15s., and of single ticket 8s. 6d. The President and Countess Rothes have stated their intention of being present, and so also have several Past Presidents, including the Principal. Early application for tickets should be made to the Hon. Secretary, Faraday House O.S.A., Southampton-row, W.C.1.

THE NEVSON TANGRAPH RULE.—From G. Cussons, Ltd., Lower Broughton, Manchester, we have received an example of the Nevson "Tangraph" rule, a device which should be of much use to students, draughtsmen, research workers, and others who may require to draw tangents to curves or to lay down a straight line among a number of experimentally determined plotted points which are known, or are supposed, to obey a straight line law. The rule is a strip of clear thin celluloid about 10¼in. long by 1¼in. wide. A line is marked on it running along its full length at the middle of its width. At the middle of its length a transversal cuts this line at right angles and at the point of intersection a fine hole is drilled through the celluloid. On each side of this central transversal three other transversals spaced ¼in., ½in., and 1¼in. from the central one cut the longitudinal line. At 2in. and 4in. from the central hole and on each side of it additional holes are drilled on the longitudinal line. To draw a tangent to a given curve at a given point, the central hole—or the intersection of any other of the transversals with the longitudinal line—is placed over the given point and the rule is adjusted until two of the transversals symmetrically situated with respect to the central hole are cut by the curve in equal ratio, a condition which can be readily judged by the eye. The point of a pencil is then inserted through any two of the holes on the longitudinal line. The two points so marked are subsequently joined, using the rule itself if desired as a straight-edge. The line so obtained will be the tangent to the given curve at the given point, or at least something very close to it in the majority of cases. The process is mathematically accurate if the curve is a circle and is sufficiently accurate for most practical purposes for any other curve the radius of curvature of which changes but little over a length of about one, two, or three inches of the curve in the neighbourhood of the given point. It should be used with discretion at or near any point of inflexion in the curve. For drawing a straight line graph the rule is adjusted over the plotted points until they are judged to be evenly distributed above and below the longitudinal line. A pencil point is then used as before to mark the paper through two of the holes on the longitudinal line, the two marks being subsequently joined by a straight line. The rule is divided in inches along one edge and in millimetres along the other. As it is very flexible, it can be used as a French curve.

* By Mr. W. F. Watson in the *Human Factor*.

Canadian Engineering News.

(By our Canadian Correspondent.)

New Port Facilities.

The port of Sorel, 45 miles below Montreal, is to have a large increase in grain storage and handling facilities next year, according to plans which involve doubling the capacity of the elevator operated by North American Elevators, Ltd. The elevator will be brought up to 4,000,000 bushels capacity by the building of an extension to the present structure. The existing elevator is a thoroughly modern unit with two towers capable of unloading waterborne grain at a rate of 40,000 bushels per hour and rail-transported grain can be received through a car unloader at the rate of seven cars per hour. The present storage capacity is 2,000,000 bushels.

Railway "Dope" Laundry.

The establishment of a "dope" laundry by the Canadian National Railways has resulted in the saving of many thousands of dollars and is being watched with interest by railway experts in various countries. "Dope" is the material composed of coarse strands of wool and cotton intertwined into a mass and when soaked in oil is used to lubricate the hub bearings of railway cars. The "dope" laundry is capable of reconditioning 5000 lb. of "dope" in eight hours, the reclaimed product meeting all the requirements of the original. The oil is re-purified and even the sediment collected from the dirty oil is made use of by the railway.

Russian Crude Oil.

One party to the three-cornered arrangement by which Russian crude oil was traded for Canadian aluminium products has, it is reported, decided to withdraw from the transaction. The Lasalle Petroleum Refinery Company, of Montreal, has announced that it will not be prepared to accept further shipments of the oil. Two shipments, totalling about 25,000 tons, have been received in tankers from Batum in the Black Sea. The oil was turned over to the Lasalle Company, and the value credited to the Aluminium Company of Canada to pay for exports of aluminium ordered by the Soviet Government. The deal has been stated to involve approximately 1,000,000 dollars' worth of aluminium products.

Employment Measures.

With thousands of men being taken from the ranks of the workless and provided for in work camps distributed throughout the Dominion, and with hundreds of families settled on farm lands, Government officials are confidently anticipating that much of the distress which has characterised the last two winters of the depression will be eliminated. Under various Departments of the Dominion Government, work, food, and shelter are being furnished to men in properly established and well-regulated camps, while the Provincial Governments are continuing this winter their extensive programme of road construction.

Aluminium.

Japan was a large purchaser of Canadian aluminium during last November. The quantity was, in fact, considerably greater than the total shipments of aluminium to Japan throughout the entire calendar year of 1931. Shipments to Japan in blocks, &c., aggregated 4,100,600 lb., valued at 616,479 dollars. In the same month Great Britain took 2,829,900 lb., valued at 440,708 dollars. Total exports for November were 7,210,100 lb., compared with exports of only 548,000 lb. in October. During the twelve months ended November, Canada exported aluminium in the same classification to the extent of 18,488,300 lb., valued at 2,818,747 dollars, and in the previous twelve months 29,486,900 lb., valued at 4,974,431 dollars.

A Large Nickel Plant Re-opened.

The International Nickel Company of Canada, Ltd., has re-opened the Orford process plant at Copper Cliff, Ontario, providing part-time employment for 300 men recruited from former employees. An official announcement states that sufficient blister copper will be produced to meet the requirements of the Ontario Refining Company, Ltd.—an associated company—which is transferring consignments of electrolytic copper to Great Britain to meet the demands of the British consumer. The Orford process was used at the Port Colborne, Ontario, refinery of the company until late in 1931, when it was transferred to Copper Cliff in order that blister copper could be turned over directly to the adjacent electrolytic refining plant of the Ontario Refining Company, the nickel sulphides only being shipped to Port Colborne.

Machinery.

The Toronto Industrial Commission reports that a manufacturing arrangement has been concluded whereby the Toronto plant of the Dodge Manufacturing Company, Ltd., has started to manufacture the complete line of products of the Portable Machinery Company, of York, Pennsylvania, U.S.A. The Dodge Company will manufacture the American company's products for Canadian and other British Empire markets.

Railway Earnings and Economies.

Since 1928, when the peak value in railway revenues in the Dominion was touched, the trend of railway earnings has been steadily downward. In 1929 the Canadian National Railways' all-inclusive gross revenues showed a decline of 13,000,000 dollars from 1928; in 1930 the decline from the previous year amounted to 48,000,000 dollars; 1931 saw a decline of 50,000,000 dollars from 1930 and to the end of 1932 the decline was about 38,000,000 dollars as compared with 1931. The total decline in receipts in 1932 as compared with 1928 amounted to approximately 150,000,000 dollars, or 48 per cent. For every dollar which the Canadian National received in 1928 it received in 1932 only 52 cents. To meet the situation economies have been effected through the elimination of unprofitable services, the reduction and reorganisation of the supervisory staff, closing of stations and office buildings, laying off a large number of employees, including many previously on part time, and by such other measures as could be made effective without bearing too heavily upon the communities served. In 1929 the total number of persons employed by the Canadian National was 111,383; by the end of 1932 this number had been reduced to 77,000.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondents.)

Industrial Position.

WHILE the volume of business in hand in the heavy industries in the Midlands and Staffordshire is far from satisfactory, it is very slowly growing, and there is a quiet confidence in the ultimate revival of trade in the basic industries of the district manifest amongst industrialists. A large number of consumers of iron and steel anticipate the receipt at the British Industries Fair of large orders for their products, and these would necessitate the placing of contracts for raw material. Just now there are no appreciable stocks of material at the works. For some time past manufacturers have exercised great care to keep down stocks of raw material. Not until practically all available supplies have been used up would they place fresh orders. Finance has been so tight that they could not afford to have capital outstanding in stocks of material. They knew they could get their requirements satisfied almost immediately and they naturally preferred the producer to stand the outlay. At date there is no urgency of demand, either for iron or steel, raw or finished. Present needs are covered and material can be had just as soon as it is required. Under these circumstances the Birmingham iron market is quiet. Except for some upward movement in billet and scrap prices there has been no important development during the week. Manufacturers say that the present range of prices is not sufficiently remunerative, and they would welcome a firmer tone. The movement in the minor branches of the steel trade is, therefore, welcomed as a step in the right direction. The revival of the International Steel Cartel tends to upset the market somewhat. Continental firms have not as yet declared their selling prices, and users of foreign material in this area are awaiting a declaration as to future values. A few manufacturers, having run short of material, have placed small orders with local iron and steelmasters, but it is too early to try and determine whether the reforming of the Cartel will result in business being transferred to local firms. There are those who hold the opinion that the Cartel is doomed to failure, at any rate, in so far as price control is concerned. They point to futile past efforts and claim that the position to-day is more difficult than it has been in the past. At date business with the Continent is suspended. A development in some seasonal trades which come to life normally in the spring is expected in the near future, and manufacturers connected with these branches of industry are now circulating inquiries for material. The general industrial position is, at least, maintained, if not slightly improved.

Ironworks to Reopen.

It is understood that Old Hill Ironworks, belonging to N. Hingley and Sons, which have been idle since last September, will resume operations early in April. For several years before last autumn the works were on short time, but the plans now in hand will, it is hoped, keep the works when again opened more fully employed. New plant is now being laid down and some eighty men have been engaged in converting the existing equipment. The works were started in 1882 by the late Sir Benjamin Hingley.

Better Trade this Year.

A hopeful view of industrial recovery during the present year was expressed by Sir Herbert Austin at a meeting in Birmingham recently. Sir Herbert said he had no doubt they were going to see a better year in 1933 than in 1932. His firm had received something like 40 per cent. more orders during the last three or four months than in the corresponding period last year, and he thought that was a healthy sign, because people did not buy motor cars unless they could pay for them. He also knew of other industries that were doing better, and it was all helping to give people greater confidence and hope for the future.

Heavy Edge Tools.

The heavy edge tool industry in the Black Country area is, at date, in a much sounder position than it was at the beginning of the year. During the past six weeks employment has increased at many of the works, and firms' order books, which were practically empty at the opening of the quarter, now contain some fairly substantial orders. South American buyers are ordering steadily, some fair-sized commissions coming to hand, and South Africa is also an improving market. There is but little business with Australasia, but the Eastern trade has undergone a slight change for the better. Moreover, it is the considered opinion of many of the manufacturers that, speaking generally, the prospects of the industry are better than they have been for a considerable time. Firms which have been on short time for a long period are gradually bringing departments into something like normal condition again, and in one instance a local firm has had to work a little overtime to cope with pressing requirements. The chief source of dissatisfaction at the moment is unsatisfactory selling prices. Complaint is general that prices are down to a minimum and business is not very remunerative.

Steel.

Steel works are short of orders in all departments. Specifications for heavy steel from the Black Country steel works are mainly limited to small tonnages, and inquiries are scarce. The position of the structural engineering trade is but little better. There is a dearth of orders, though one or two extensive projects have been responsible for some inquiries at the steel works in the last few days for structural material. Orders are given out sparingly with few exceptions. The main currents of trade are moving sluggishly. Though import business with the Continent has continued to diminish, the result has not been to set up any noticeable demand from the home markets. Current demand is well within the capacity of home suppliers. Finished steel prices show no change on the week. Sales are made on the terms as fixed by the Steelmasters' Association. In the half-products branch selling values tend upwards. The advance of half a crown per ton on mild steel billets now demanded by makers who recently recognised £4 17s. 6d. as the minimum for orders of 500 tons and upwards was only what had been anticipated. For some weeks now makers have been endeavouring to raise the minimum level. Re-rollers would like to put up prices of bars, but they are still waiting for their turnover to revive. They are not doing so well as they were at the beginning of the year. Though they are having to pay more for their raw material, they are, for the moment, unable to pass on the increase to their customers. They quote re-rolled bars at £6 15s., but in many instances do business at £6 12s. 6d. All-British bars they quote at a minimum of £7 per ton.

Pig Iron.

Northamptonshire and Derbyshire blast-furnacemen are not satisfied with the position as it exists to-day. While contracts have been placed for considerable tonnage over the next few months, foundrymen are not specifying freely. Consequently, stocks at the furnaces are again increasing. An increased demand from the light castings foundries in the near future is, however, looked forward to. There is sure to be a seasonal revival of building in the spring, and the probability is that expansion will exceed the normal seasonal dimensions. The light foundries are just now limiting their output to actual sales, but as soon as the forward movement commences, they are likely to push along with production, and this will necessitate the use of much larger tonnages of pig. Even at date quite a considerable amount of foundry iron is being absorbed by the light castings foundries in this area. It is in the heavier lines of engineering that demand remains so poor. Prices of foundry iron are £3 2s. 6d. for Northamptonshire No. 3, and £3 6s. for Derbyshire, delivered Black Country stations. Basic iron is £3 2s. a ton delivered. There is very little demand for forge material, which costs 5s. a ton less than foundry.

Manufactured Iron.

In the Staffordshire finished iron trade the rolling mills are unable to make full time owing to the scarcity of specifications. There is, however, a hopeful tone, due to the fact that consumers who have been holding back for some considerable time have come forward with inquiries. This is regarded as a healthy sign, even though the business booked only relates to small tonnages. The most favoured section remains, that producing best grade bars, for demand is extended over a fairly wide area. Crown bars are slow of sale, while common bars are in really poor request, despite the fact that some of the consuming industries in the Black Country, such as the bolt and nut trade, are rather more active than they were. The call for wrought iron gas tube strip is not too bad, but some of the manufacturers consider themselves fortunate to be operating a five-day week in the present circumstances. There has been no change in selling prices in any branch during the past week, and quotations are as given in last week's letter.

Galvanised Sheets.

Galvanised sheets are in better demand for the home market, and some of the mills are well occupied. Conditions are very difficult in the export trade, and progress is slow. Few overseas buyers are purchasing at the normal rate. Moreover, of the business available not a little is taken by Belgian sheet makers. They compete keenly for all orders. Native mills adhere firmly to the selling prices as jointly fixed, but it is rumoured that some producers are in favour of a reduction in selling rates for export business. Others hold that the work is not available, nor would it become so as a result of lower prices, though financial stringency is admittedly responsible for the relatively poor demand. Galvanised corrugated sheets of 24-gauge are quoted £10 10s. f.o.b. for export, and £11 15s. delivered in lots of 10 tons and upwards, with graduated increases for smaller lots, for home consumption. Black sheets are £8 10s. f.o.b. and £9 10s. upward, according to tonnage, for the home trade.

Scrap.

Merchants and other Birmingham dealers in steel scrap have attempted to enforce a new standard of 32s. 6d. a ton for material delivered into Black Country works, but buyers are very reluctant and, in some cases, have refused to pay more than 31s. There is a feeling, however, that a definite upward movement has begun, and this is backed by the stronger tone of the market in South Wales. Most merchants here are holding out for the higher price.

A Machine Tools Demonstration.

During the Fair weeks Alfred Herbert, Ltd., are holding a special demonstration of modern machine tools in their Birmingham showroom, 208, Corporation-street. The machines will be shown producing typical work, and include several of entirely new design which will be demonstrated for the first time. A series of lectures on machine tool development and modern equipment,

and one covering optical measuring instruments, is being arranged. Engineers visiting the British Industries Fair are invited to this demonstration.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Engineers and the Chinese Market.

LANCASHIRE engineering firms are hopeful of improving the amount of business that they are doing with China, and assistance in this direction is expected to be derived from the Vice-consulate which the Chinese Government has just established in Manchester, and from a similar development which is expected shortly at Liverpool. In both cities Chinese consular offices have been opened within the past three months. Mr. M. H. Young, who has been appointed Chinese Vice-consul in Manchester, is the son of a Penang merchant and a graduate of a Chinese university. Mr. Young's opinion is that the prospects of securing Chinese orders are particularly bright for North of England engineering firms, because China is at present embarking upon the task of equipping herself as an industrial country, and he has great hopes of a substantial increase in the volume of trade between Lancashire and China, to the mutual advantage of both.

Oilfields Plant for Russia.

Credit difficulties during the past twelve months have been the cause of a good deal of business for Russia being diverted from Lancashire machine tool makers and other engineering concerns in the county and also in Cheshire. Another instance of this has come to light during the past week, this time from a firm specialising in the manufacture of oilfield plant. The Oil Well Engineering Company, Ltd., of Cheadle Heath, near Manchester, state that a valuable order for oilfield machinery which they had hopes of securing from the Russian Government has been placed with a German firm, who were in a position to grant four years' credit terms, whereas the credit guarantee of the British Government did not extend beyond eighteen months. Formerly, most of the plant of this kind was purchased by Russia in the United States, but it is understood that recent developments in the latter country, mainly connected with tariff measures, have largely put an end to the trade.

Contract for Air-conditioning Plant.

A contract of the value of £10,000 for air-conditioning plant for a new Liverpool factory has been secured by the Andrew Machine Construction Company, Ltd., of Stockport. The hourly capacity of the plant is said to be about 9,000,000 cubic feet of air.

Non-ferrous Metals.

Conditions on the markets for non-ferrous metals during the past week have been irregular, both from the point of view of prices and of the movements into consumption. After a steady decline extending over the previous four weeks or so, values of standard brands of copper have improved on balance for the week to the extent of about 2s. 6d. per ton, and rather more buying interest has been shown in this section, both in respect of standard metal and of manufactured copper. Following upon the rise in tin during the past fortnight, there has been a certain amount of reaction, current quotations representing a fall of from 10s. to 12s. 6d. per ton. The demand has been quieter than before, but the fact that there is a continued improvement in the home statistical position, coupled with the absence of any pronounced selling pressure, helps to keep quotations reasonably steady. A decline of about 5s. per ton in the case of lead, after pronounced steadiness for a month, has brought values back to where they were early in January. On the whole, however, business in this metal is believed to have been slightly better than of late. The tone of the spelter market has been healthier this week than at any time since the closing month of last year, although after a relatively substantial advance in prices the value at the moment of writing is no more than about 1s. per ton above last week's parities. In this section also interest from buyers has been rather more in evidence.

Iron and Steel.

Apart from the fact that a little more inquiry has been reported among Lancashire constructional engineers, conditions on the iron and steel markets have not changed appreciably during the week. The slight expansion of buying, both in the foundry iron and the steel sections, has died away, and apart from the usual flow of retail orders consumers are believed to have filled their requirements for the time being. Textile machinists are no busier and general foundries in the district could, in most instances, do with more work. Under the circumstances, having regard to the heavy supplies of scrap that continue to be offered at low rates, it is satisfactory to be able to report that the movement of foundry iron into consumption locally has been maintained at its recent level. Prices are steady at 67s. per ton, delivered in the Manchester district, for Derbyshire, Staffordshire, and Cleveland No. 3; 65s. 6d. for Northamptonshire; 62s. for Derbyshire forge iron; about 82s. for Scottish foundry, and 80s. 6d. for West Coast hematite. The bar iron trade is quiet, but values keep up on the basis of £10 5s. per ton for Lancashire best bars and £9 15s. for Crown quality material. Orders in the steel trade, except in one or two sections, relate to a small tonnage in the aggregate, mainly for early delivery, although the fact that constructional engineers are handling a somewhat better volume of inquiry holds out some promise of improvement later on. In the meantime small re-rolled bars are quoted at from £6 12s. 6d. to £6 15s. per ton, with acid and basic boiler plates at about £8 10s., ship and tank plates at £8 17s. 6d., frame plates (including surface inspection charges) at £9 2s. 6d., sections at £8 7s. 6d., joists at £8 15s., and large diameter bars at £9 7s. 6d.

BARROW-IN-FURNESS.

Hematite.

There is little fresh to report in the hematite pig iron market, which has not shown any signs of expansion recently. Certainly, there is a slightly better tone and makers are delivering a little more; but there is no sign of a substantial revival. One of the first signs of that change will be the stiffening of prices, for it is generally admitted that the present rates do not yield much profit, if any. There have been a few deliveries recently to the Continent, but, comparatively speaking, the tonnage has been light. Home buyers maintain recent demands. America does not figure as a buyer yet, neither does Canada. The iron ore trade is quiet, but steady, and this applies to both native and foreign. The steel market is also quiet, and there are not many orders obtainable. The Barrow hoop, special section and rail mills are engaged, but fresh orders for railway material would be welcome. Shipping is quiet; fuel is in steady but moderate demand.

Shipbuilding and Engineering.

The order for a Brazilian training ship, entrusted to Vickers Armstrong, is confirmed. The cost will be in the neighbourhood of a third of a million pounds. The Admiralty contracts are not fully placed yet, and it is difficult to say to whom some of them will go. It has been stated that the total value of orders to Barrow will be in the neighbourhood of 3 million pounds. At one time, it was thought that the order for the destroyer depôt ship would be placed with Vickers, but it is now believed that Belfast, which is placed badly for work, may get it. Work has been started at Barrow on the 7000-ton cruiser "Ajax."

SHEFFIELD.

(From our own Correspondent.)

Steel Trade Prospects.

A CERTAIN improvement in the local steel industry is becoming more marked as the year progresses, and during the past few days there have been indications that more work will be available in the near future. For instance, the crucible and special steel departments are becoming more active, and the announcement of the placing of the contracts for the 1932 Naval programme is welcomed as evidence that more work will be coming to one or two of the large Sheffield steel firms. But production of crude steel and various classes of manufactured steel has not advanced since the slump, which occurred about Christmas time, and the plants producing springs and parts for heavy road vehicles have been almost at a standstill since the publication of the Salter report.

Production Statistics.

Figures are now available of the total production of steel ingots and castings in the United Kingdom last year. The output amounted to 5,256,800 tons, compared with 5,202,600 tons in 1931, and Sheffield's share of the total was 14·6 per cent. last year, whereas in 1930 it was only 11·4 per cent. During the month of December production of steel in the Sheffield area amounted to 59,600 tons, compared with 70,000 tons in November, and 63,200 tons in December, 1931. Lincolnshire's production during the same month was 32,800 tons, comparable with 40,900 tons during the previous month.

Naval Contracts.

As already mentioned, Sheffield will obtain a considerable amount of work through the placing of the contracts for cruisers, flotilla leader, destroyers, and sloops of the Navy's 1932 programme. Hulls and machinery for destroyers are to be made by Cammell Laird and Co., Birkenhead and Sheffield; J. Brown and Co., Clydebank and Sheffield; and Vickers-Armstrongs, also with Sheffield interests. In addition, Vickers-Armstrongs, Ltd., have obtained an order for the construction of a new training ship ("Saldanha Dagama") for the Brazilian Navy, at a cost of £314,500, the order having been secured in competition with sixteen other firms.

Cutlery and Tools.

Although there is a good demand from bazaars and coupon firms for mass production cutlery, there is little call for medium and best quality articles. Sales of scissors and razor blades maintain a high level, however, and the production of various kinds of tool knives is substantial. The British Army authorities are inviting tenders for 89,000 unplated spoons, 92,000 unplated forks, 93,400 table knives, 18,000 clasp knives, and 3000 cooks' knives. The season for farm tools has opened quietly there being little demand, whilst the Irish market, generally good, is practically stagnant. Local manufacturers are supplying large quantities of cutter blades for new brands of British lawn mowers.

Work at L.M.S. Station.

Important improvements and alterations to the L.M.S. station at Sheffield are to be carried out during the next two years. The first item in the programme is the replacement of the extensive glass roof, and this work is now in progress. The whole of the old structure is being replaced, and the new roof, with larger glass panes, will be supported by patented glazing bars. The effect of this work will be considerably to brighten and lighten the station.

Roads and Bridges.

An expenditure of approximately £30,000 has been made through the Nottinghamshire County Council in widening and resurfacing the Great North Road and the Nottingham–Bawtry Road, upon which further work is now proposed. This authority also intends to widen Carol Gate Bridge, Retford, at a cost of £2300, and consideration is being given to a scheme for the widening of the road and increasing the height of the railway bridge near Farnsfield, at an estimated cost of £11,300. The Grimsby Corporation has provisionally accepted the tender of Fletcher and Co., Mansfield, for the construction of a subway on the Wellsby-road, Grimsby, at a cost of £11,358. The subway will effect a considerable improvement on the main road between Grimsby and Cleethorpes, and its total cost will be about £20,000.

NORTH OF ENGLAND.

(From our own Correspondent.)

The Naval Contracts.

THE Admiralty contracts which have been allotted to the Tyne did not come up to expectations in number or the amount of work involved, but they are, nevertheless, very welcome. Keen disappointment has been occasioned that Jarrow has not received an order, and representations are to be made to the Admiralty by a group of Northern Members of Parliament. The plight of Jarrow is worse than that of any other shipbuilding town in the country. At the moment 80 per cent. of the workers are unemployed, and, in view of the commercial depression, there is little prospect of early work on mercantile construction. In view of the questions that are being asked as to the prospects of employment at their works this year, Swan, Hunter's have issued a statement regarding the orders they have received and the ships they are to build up to the present time. Three years ago the firm was employing about 7000 men, but at the beginning of this year the number was less than 1000. In a few months it is expected that about 3000 men will be employed for the remainder of the year.

Cleveland Iron Trade.

There is no marked change to record in the position of the Cleveland pig iron trade this week. Home consumption is increasing, but demand from abroad continues light. Confidence in the future is strong. Movement in the direction of remodelling producing plant is now taking place. It is fully recognised that the old types of blast-furnaces are unsatisfactory, and Dorman, Long and Co., Ltd., have begun to modernise the blast-furnace plant at their Cleveland Works. An old furnace, with a production capacity of 200 tons per day, is being replaced by a new furnace with a capacity of 400 tons per day. Quotations to buyers on Teesside stand:—No. 1 Cleveland foundry, 65s.; No. 3 G.M.B., 62s. 6d.; No. 4 foundry and No. 4 forge, 61s. North of England purchasers outside Teesside are charged 2s. above these figures, and delivery prices to customers in the Glasgow area are based on No. 3 quality at 62s. 9d. Export prices are unaltered.

Hematite Pig Iron.

There is a good deal more activity in the hematite trade than in Cleveland pig iron, which is not altogether surprising in view of the relative prices. Good sales of hematite have been made recently, and where possible it is being used in preference to foundry iron. East Coast mixed numbers are selling freely at round about 59s., with No. 1 quality at a premium of 6d. per ton.

Iron-making Materials.

Movement in the foreign ore trade is slow, and nominally prices are ruled by best Rubio at 15s. 3d. c.i.f. Tees. Market transactions in blast-furnace coke are few, but sellers keep quotations on the basis of good average qualities at 16s. delivered at North-East Coast works.

Manufactured Iron and Steel.

Slightly better accounts are given of the manufactured iron and steel trade. The new naval and shipbuilding orders have created great satisfaction, and the reconstitution of the European Cartel and the rise in Continental prices is a bull point for the home steel trade. The demand for semis is improving. Prices are steadily maintained.

The Coal Trade.

There is now considerable interest in the forthcoming opening of the Canadian shipping season, for a good deal of coal and coke has already been sold to the Dominion, and more inquiries are being received. Tonnage has been taken up in readiness for the first open water in the St. Lawrence, and there are expectations of more vessels being fixed in that direction. On February 28th tenders are due to the Swedish State Railways for the supply of 110,000 tons of locomotive coal to be delivered over six months. There are hopes that a good part of the order may come to the North-East Coast, but competition is sure to be strong from Poland and Westphalia. The recent firm tone of the market is maintained. For prompt deliveries there is practically no steam coal on offer, and for any lots becoming available, holders obtain full recent prices. For the latter part of the month fitters report being sold to the quota limitation, but the contractors are finding difficulty in clearing their commitments, and are offering considerable quantities at rather easy prices. Best Northumberland steams are quoted at 13s. 9d. to 14s. Continental consumers, however, are not pressing on the market. Durham best steam are quoted at 15s. 6d. to 16s. Tyne primes are steady at 13s. 3d. to 13s. 6d., and other qualities firm at 12s. 6d. Small steams are offered in moderate quantity at 8s. 6d. for best qualities. There is no revival of interest in the demand for gas coal for early shipment, and several brands which have recently enjoyed brisk trade are showing signs of easing down and offering more plentifully. Best qualities hold steady at 14s. 6d., and prime Wear gas at 15s. Secondary gas coal is pressing on the market at 13s. to 13s. 6d. Durham unscreened bunkers are in improved supply and tend easier at 14s. to 14s. 6d. for best sorts. The coke market is in good tone and prices firm for gas qualities for early delivery, but for next month orders come forward slowly, as a result, apparently, of mild weather on the Continent.

Best gas coke is quoted unchanged at 18s. 6d., and vertical at 22s. Patent oven coke is in ample supply, and the demand disappointing. Prices are quoted easy at 15s., with superior brands at 15s. 6d. to 16s. Coke nuts are unchanged at 16s. 6d. to 17s. 6d.

SCOTLAND.

(From our own Correspondent.)

Position Unchanged.

THE position in the steel, iron, and coal trades has not altered appreciably during the past week. Recent shipbuilding orders and a continued inquiry for new tonnage help to preserve the feeling that the corner has been turned, and that the succeeding months of the year may witness a decided movement towards more prosperous times. At any rate, steelmakers and others have and are still making every possible effort to be ready to meet any increase in demand, and it is said that many are now better equipped than at any time in their history. General conditions are still comparatively quiet, but specifications in connection with recent contracts must soon make some difference, and thereby help to stimulate employment at the shipyards and in the engineering shops.

Steel.

Heavy steel promises to improve by virtue of recent shipbuilding orders. The total tonnage is not particularly large, but producers are more confident of a continued flow of business, especially in view of the reconstitution of the Continental Steel Cartel and the possibility of increased prices abroad. Steelmakers report a continued improvement in the demand for light grades for export. Inquiries from the Far East are maintained, and there are prospects of a fair expansion in business at the opening of the Canadian season. Heavy sheets and galvanised descriptions are still rather slow. The production of steel tubes is continued on recent lines, although the demand has not yet opened up as expected.

Bar Iron.

Conditions in the bar iron trade are still most unsatisfactory, and there is no prospect of an early improvement. Re-rolled steel bars, too, make little headway in competition with Continental material, with the home quotation still at £7 5s. per ton, and export at £6 10s. per ton.

Scrap.

Heavy steel scrap is firmer at 37s. 6d. to 40s. per ton, and cast iron machinery has risen from 47s. 6d. to 50s. per ton.

Pig Iron.

During the week the price of No. 3 foundry iron was reduced to 65s. per ton, with No. 1 unchanged at 70s., and hematite at 66s. per ton. Recent reductions have failed to effect any improvement, and the output of the two furnaces in blast is still sufficient to meet all requirements. Last week two consignments of pig iron arrived here from Calcutta, amounting, in all, to 3050 tons, and, in addition, 700 tons arrived from Barrow and Workington.

Coal.

The Scottish coal market does not show any change of importance. West of Scotland fuels are a shade easier for export, supplies being a little more plentiful owing to a decline in household demands, leaving more fuel available for shipment. Importers abroad, however, are not enamoured of colliery prices, and with shippers disinclined to discount current quotations, business is of a small day-to-day character. Lothians steams and navigations move freely, but best Fifeshire steams are not too plentiful and are well held. Washed nuts, as a rule, have an easier tendency. Aggregate shipments amounted to 249,190 tons, against 242,881 tons in the preceding week, and 228,367 tons in the same week last year. The Swedish State Railways are asking tenders for 100,000 tons of fuel, offers to be presented on or before February 25th.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

The Coal Trade.

SHIPMENTS of coal and coke from the six leading ports in this area last week were better than was anticipated. The total came to 393,260 tons, which was 17,325 tons more than in the preceding week, and compared with 363,414 tons for the corresponding period of last year. At one time it certainly looked as if the figures for last week would be well below the average, but clearances of steamers on Friday were on a heavy scale and represented a total quantity of coal of over 60,000 tons. With such an exodus of tonnage, it was not surprising to find on Saturday last that the docks were in a somewhat denuded state, the number of idle tipping appliances reaching forty-seven. Arrivals of steamers over the week-end were on a fair scale, with the result that on Monday the number of idle tips was twenty-one, but this figure rather flatters the situation, for the real position is that many vessels are getting long loading turns owing to the scarcity of sized coals. As a matter of fact, the inquiry from abroad displays no improvement. The strike of about 27,000 miners in the Asturias coalfield has so far brought no demand from Spain for early supplies of coal, and, so far as the inquiry from the Swedish State Railways for 110,000 tons of coal is concerned, it is not expected that much, if any, of this order will be placed for South Wales coals.

Coal Quotas.

It cannot be said with certainty, but, possibly, may be the case, that foreign buyers are not disposed to operate ahead in the belief that perhaps steps may be taken to remove export coals and bunkers from the operation of Part I. of the 1930 Coal Mines Act, which controls production and prices. Removal of control and the restoration of complete freedom would unquestionably have the effect of bringing about a reduction in coal prices, especially of South Wales coals, which are so much higher than those produced in other parts of the country. It is, of course, well known that coal exporters and some coalowners are strongly in favour of export coals and bunkers being freed from statutory control, and for this purpose an influential deputation from the Coal Exporters' Federation had an interview with the Secretary of Mines on Thursday of last week, when Mr. Brown promised to give his most serious consideration to the facts and arguments put forward. Whether anything will come of the interview is doubtful, as it is well known that miners' leaders are so much in favour of the existing conditions in respect of statutory control. Another matter of interest to this industry is that the Maritime Chambers of Commerce of France are protesting to their Government against the decree recently issued by which the coal import quota was reduced as from the 1st inst. from 70 to 65 per cent. of the datum period. The Maritime Chambers of Commerce put forward that the reduction is detrimental to French industry, ports and shipping, as well as to the private consumer.

Miscellaneous Items.

When the Executive Council of the South Wales Miners' Federation met at Cardiff last week, reference was made to the terms of the new Minimum Wage Bill which had been considered by a committee of the executive. Among the alterations suggested was that, in the event of a disagreement between members of the District Board, the points at issue should be referred not to an independent chairman, as hitherto, but to a board constituted under the Industrial Courts Act of 1919, which will be empowered to give a final decision. Reference was made a week ago to the prospect of a Cardiff firm of shipowners placing an order for two steamers. This is now confirmed, the order having been given to the Furness Shipbuilding Company, of Middlesbrough, while Doxford and Sons, Ltd., of Sunderland, have secured the order for Doxford opposed piston oil engines.

Glamorgan's Relief Bill.

The statement of estimated expenditure submitted last week to the Glamorgan Public Assistance Committee showed that £1,038,928 would be required to meet the expenditure during 1933–34, as compared with £1,008,035. The sum included an item of £20,000 which it was decided to eliminate. It was stated that the Committee would have to pay £35,416 from the rates towards the repayment of loans in the coming financial year, which meant 4d. in the pound on the rates. It was decided to approach the Members of Parliament, and to send another deputation to the Ministry of Health in order to see if some relief could not be secured.

Current Business.

The quietness of the steam coal market continues to be unrelieved. Large coals, particularly, get very little inquiry, but the pressure for sized qualities is unabated and prices remain firm. Anthracite coals maintain a good tone, and supplies of most descriptions are readily absorbed. Difficulty is met with in securing prompt anthracite coals, and in the early part of this week this difficulty was accentuated by the fact that the miners at the Gwaun-Cae-Gurwen colliery were reported to be on strike on the non-unionist question. Hopes were entertained that this stoppage would not be of long duration. Coke moves off freely and promises to be in increased demand as the steel and other works extend their operations. Patent fuel is steady, but pitwood is very quiet at prices ranging from 19s. to 20s.

Fuel Works to Resume.

British Briquettes, Ltd., who control the Arrow Fuel Works at Newport, intend reopening the works almost immediately. The works, which have been closed for about two years, will give employment to about 100 men. Continuance of employment will, of course, depend upon the state of trade, but work is expected to be available for several weeks at least.

British Standards Institution.

All British Standard Specifications can be obtained from the Publications Department of the Institution at 28, Victoria-street, London, S.W.1. The price of each specification is 2s. 2d. post free, unless otherwise stated.

RAILWAY SIGNALLING SYMBOLS.—WIRING SYMBOLS AND WRITTEN CIRCUITS.

No. 376, Part 2—1933. There has just been issued by the British Standards Institution the new Railway Signalling Symbols, No. 376, Part 2, Wiring Symbols and Written Circuits. These symbols are for use on wiring diagrams and contain a clear and full explanation of the method of labelling various pieces of apparatus according to the functions for which they are used. This publication also gives very full notes and explanation of the written circuit system of preparing diagrams, a method which has begun to be used very widely. This type of diagram is clear and readily understood, and easy and inexpensive to draw compared with the more elaborate wiring diagrams. The nomenclature adopted for the wiring symbols and the written circuits is also included. The Committee which has prepared these symbols is under the chairmanship of Mr. A. F. Bound, and is formed of representatives of all the British railways, of the Institution of Railway Signal Engineers, and also of representatives of the Overseas Dominions and India.

AIR-BREAK SWITCHES.

Revision of B.S. Specifications Nos. 109 and 124. The British Standard Specifications for Air-break Switches and Circuit Breakers were first issued in 1923, and revisions of two of these specifications are now available, viz., No. 109, Air-break Knife Switches and Laminated Brush Switches; and No. 124, Totally-enclosed Air-break Switches. Both these specifications apply to switches for voltages up to 660 volts. Perhaps the feature of most general interest regarding these revisions is the new temperature limitations, which have been brought into line with the temperature limitations imposed by the recently issued revision of the B.S. Specification for Busbars. Another point of difference between the old and the new editions is that the range of sizes has now been extended to include a rating of 15 ampères, while only two standard voltage ratings are now recognised in place of the former three. A test for breaking capacity is now included in both specifications, and in several other respects detail improvements have been incorporated.

SYNTHETIC RESIN (PHENOL-ALDEHYDE TYPE).

No. 474—1932. The advent of synthetic resin has given the electrical industry a valuable insulating material for the manufacture of paper boards, tubes and cylinders. After extensive researches on the properties of this class of material, a British Standard specification has now been issued. The material used to bind the layers of paper in the manufactured boards and tubes must obviously be an insulator, and the next most important characteristic required is adhesiveness. Experience has shown that a synthetic resin when transformed may, or may not, be a sufficiently good adhesive to serve as the bond between layers of paper. It was found that while a given batch of synthetic resin had the necessary adhesiveness, a succeeding batch might fail in this respect. It is clear therefore that a standard method of test for this property is very desirable to avoid disputes between purchaser and supplier.

In view of the fact that this is the first British Standard specification for this class of insulating material, the requirements have been limited to a few essential properties, and the methods of test as specified are as simple as practicable. For this reason an electric strength test on varnished tissue paper—the simplest form of this type of test available—is specified. The specification also covers definitions of "green" and "liquid" resin, the strength of solution which must be obtained under given conditions, tolerance on melting point (owing to the wide variation in users' requirements it is not practicable to specify a melting point), and a clause to limit the amount of untransformed resin after a given heat treatment.

CONTRACTS.

THE CAMBRIDGE INSTRUMENT COMPANY, Ltd., of 45, Grosvenor-place, London, S.W.1, has recently received orders for temperature and pressure recording instruments for measuring the temperatures and pressures in oil stills, superheaters, &c., from the Assam Oil Company and the Burmah Oil Company, through Foster Wheeler, Ltd., Aldwych House, W.C.2.

HARLAND AND WOLFF, Ltd., Belfast, have secured a contract for the construction and erection of a new goods shed and collateral works in connection with the scheme of harbour development by the Belfast Harbour Commissioners. The new shed, which is to be erected on the west side of the Dufferin-road, will be 535ft. 3in. long by 91ft. 8in. wide and 25ft. high to the underside of the roof trusses, with a floor area of about 49,000 square feet. The whole of the front and rear of the shed will be made up of sliding gates, 10ft. 8in. wide and 17ft. 3in. high.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

UNITED MACHINE TOOL COMPANY, Ltd., and Dowding and Dickinson have been amalgamated as Dowding and Doll, Ltd., Greycoat-street, Westminster, London, S.W.1, for the sale of specialised foreign machine tools. The company is under the joint control of O. W. G. Doll and A. Graham Dowding.

BAYLISS, JONES AND BAYLISS, Ltd., Wolverhampton, have appointed Mr. C. A. Parson, 111, New-street, Birmingham, to be their representative in the Midlands for the sale of steel bars. Mr. C. A. Parson already represents the allied companies Guest, Keen and Nettlefolds, Ltd., Darlaston, and Rogerstone Works; Joseph Sankey and Sons, Ltd., Bilston; and John Garrington and Sons, Ltd., Darlaston.

MR. A. P. WOOD has resigned his position as managing director of the Lancashire Dynamo and Crypto Company, Ltd., and joined the board of Laurence, Scott and Electromotors, Ltd., of Norwich and Manchester. Mr. Wood, with the late Sir Harry Kilvert and his brother, started the Lancashire Dynamo and Motor Company at the end of the last century and has been managing director almost from its inception.

NORTON COMPANY, of Worcester, Mass., has entered into a working arrangement with the Newall Engineering Company, Ltd., of Ponders End, Middlesex, whereby the latter will make in this country Norton lapping machines for flat and round work. The machines will in future be known as Norton-Newall lapping machines. The manufacturing and designing arrangements will be under the charge of Mr. Sydney Player, formerly connected with the Bethel-Player Company, of Westboro, Mass. The selling arrangements will continue in the hands of Alfred Herbert, Ltd., Coventry.

CALENDARS, DIARIES, &c.

ETNA IRON AND STEEL COMPANY, Ltd., Motherwell.—Wall calendar.

HARLAND AND WOLFF, Ltd., Belfast.—Wall calendar.

THE IRON AND STEEL INSTITUTE.—The Council of the Institute has decided to award the Bessemer Gold Medal for 1933 to Dr. W. H. Hatfield, Director of Research, Thos. Firth and John Brown, Ltd., in recognition of his distinguished services in the advancement of metallurgical science and of his valuable researches in connection therewith.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
(1) Native	15/- to 20/-
(1) Spanish	17/- to 24/-
N.E. COAST—	
Native	18/- to 21/-
Foreign (c.i.f.)	15/3

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	3 6 0	—
No. 1 Foundry	3 10 0	—
No. 3 Foundry	3 5 0	—
N.E. COAST—		
Hematite Mixed Nos.	2 19 0	2 19 0
No. 1	2 19 6	2 19 6
(f) Cleveland—		
No. 1	3 5 0	3 1 0
Siliceous Iron	3 5 0	3 1 0
No. 3 G.M.B.	3 2 6	2 18 6
No. 4 Foundry	3 1 6	2 17 6
No. 4 Forge	3 1 0	2 17 0
Mottled	3 0 6	2 16 6
White	3 0 6	2 16 6
MIDLANDS—		
(e) Staffs.— (*Delivered to Station.*)		
All-mine (Cold-blast)	—	—
North Staffs. Forge	3 1 0	—
" " Foundry	3 6 0	—
(e) Northampton—		
Foundry No. 3	3 2 6	—
Forge	2 17 6	—
(e) Derbyshire—		
No. 3 Foundry	3 6 0	—
Forge	3 1 0	—
(3) Lincolnshire—		
No. 3 Foundry	—	—
No. 4 Forge	—	—
Basic	—	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	3 15 6 (*a*); 4 0 6 (*b*); 4 5 6 (*c*)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	9 15 0	9 5 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 5 0	—
Common Bars	9 5 0	—
Best Bars	10 5 0	—
Double Best Bars	10 15 0	—
Treble Best Bars	11 5 0	—
LANCS.—		
Crown Bars	9 15 0	—
Best Bars	10 5 0	—
Hoops	12 0 0	—
S. YORKS.—		
Crown Bars	9 15 0	—
Best Bars	10 15 0	—
Hoops	12 0 0	—
MIDLANDS—		
Crown Bars	8 12 6 to 9 5 0	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	8 0 0 to 8 10 0	—
Gas Tube Strip	10 7 6 to 10 10 0	—

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates (Marine)	9 0 0	8 10 0
" " (Land)	—	—
Ship Plates, ½in. and up	8 15 0	7 15 0
Sections	8 7 6	7 7 6
Steel Sheets, ¼in.	7 15 0	7 15 0
Sheets (Gal. Cor. 24 B.G.)	11 5 0–10 Ton	10 0 0
	Lots and Upwards Delivered Glasgow Stations.	
" (Gal. Cor. 24 B.G.)	For Canada separately arranged	

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 15 0	7 15 0
Angles	8 7 6	7 7 6
Boiler Plates (Marine)	10 10 0	—
" " (Land)	10 0 0	—
Joists	8 15 0	7 7 6
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	7 2 6	—
Soft Billets	5 10 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	—
Billets	6 10 0 to 9 0 0	—
MANCHESTER—		
Bars (Round)	9 7 6	—
" (Small Round)	6 15 0	—
Hoops (Baling)	10 0 0	9 15 0
" (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
" (Lancs. Boiler)	8 10 0	—
SHEFFIELD—		
Siemens Acid Billets	9 2 6 (basis)	—
Hard Basic	8 2 6 and 8 12 6	—
Intermediate Basic	6 12 6 and 7 2 6	—
Soft Basic	5 15 0	—
Hoops	9 10 0 to 9 15 0	—
Soft Wire Rods	7 10 0	—
MIDLANDS—		
Small Rolled Bars (all British)	7 0 0 to 7 5 0	—
Small Re-rolled Bars	6 12 6 to 6 17 6	—
Billets and Sheet Bars	5 0 0 to 5 7 6	—
Galv. Sheets	11 15 0 to 13 15 0	10 10 0
(2) Staffordshire Hoops	9 10 0	—
(*d*) Angles	8 7 6	—
(*d*) Joists	8 15 0	—
(*d*) Tees	9 7 6	—
(*d*) Bridge and Tank Plates	8 17 6	—
Boiler Plates	8 5 0 to 8 7 6	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14 f.o.b.	15/9 to 16/3
Block Tin (cash)	149 0 0
" (three months)	149 5 0
Copper (cash)	28 11 3
" (three months)	28 16 3
Spanish Lead (cash)	10 5 0
" " (three months)	10 11 3
Spelter (cash)	13 16 3
" (three months)	14 0 0
MANCHESTER—	
Copper, Best Selected Ingots	32 10 0
" Electrolytic	33 10 0
" Strong Sheets	65 0 0
" Tubes (Basis Price), lb.	0 0 10
Brass Tubes (Basis Price), lb.	0 0 9
" Condenser, lb.	0 0 11½
Lead, English	12 2 6
" Foreign	10 17 6
Spelter	14 2 6
Aluminium (per ton—raw ingot)	£95

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/10½ per lb.	
Ferro Tungsten	1/7½ per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£25 15 0	8/-
" " 6 p.c. to 8 p.c.	£24 10 0	7/6
" " 8 p.c. to 10 p.c.	£22 5 0	7/-
" " Specially Refined		
" " Max. 2 p.c. carbon	£36 10 0	11/-
" " " 1 p.c. carbon	£42 12 0	14/-
" " " 0·70 p.c. carbon	£44 0 0	16/-
" " " carbon free	1/- per lb.	
Metallic Chromium	2/9 per lb.	
Ferro Manganese (per ton)	£10 15 0 for home	
" " "	£9 15 0 for export	
" Silicon, 45 p.c. to 50 p.c.	£13 10 0 scale 5/- per unit	
" " 75 p.c.	£19 10 0 scale 6/- per unit	
" Vanadium	12/6 per lb.	
" Molybdenum	6/3 per lb.	
" Titanium (carbon free)	9d. per lb.	
Nickel (per ton)	£245 0 0	
Ferro Cobalt	7/9 per lb.	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	14/6
" " Ell	16/-
" " Splint	15/9 to 16/6
" " Trebles	14/6
" " Doubles	11/6
" " Singles	10/6 to 10/9
AYRSHIRE—	
(f.o.b. Ports)—Steam	14/-
" " Jewel	16/6
" " Trebles	15/-
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	13/- to 15/-
Screened Navigation	16/6 to 17/6
Trebles	14/9 to 16/-
Doubles	12/6 to 13/3
Singles	10/6 to 10/9
LOTHIANS—	
(f.o.b. Leith)—Best Steam	14/-
Secondary Steam	13/6
Trebles	15/-
Doubles	12/-
Singles	10/6 to 10/9

(8) N.W. COAST— ENGLAND.

Steams	19/- to 23/6
Household	32/6 to 52/6
Coke	18/- to 21/6
NORTHUMBERLAND—	
Best Steams	14/6
Second Steams	12/6 to 12/9
Steam Smalls	8/6
Unscreened	12/6 to 13/-
Household	27/- to 39/-
DURHAM—	
Best Gas	14/6
Second	13/3 to 13/6
Household	25/- to 37/-
Foundry Coke	24/-

SHEFFIELD	Inland.
Best Hand-picked Branch	27/- to 28/-
South Yorkshire Best	23/- to 24/-
South Yorkshire Seconds	18/- to 21/-
Derbyshire Best House	22/- to 23/6
Derbyshire Best Brights	18/- to 20/-
Screened Seconds	17/6 to 19/-
Kitchen Coal	16/6 to 17/6
Best Screened Nuts	17/- to 18/6
Small Screened Nuts	16/- to 16/6
Yorkshire Hards	17/- to 18/-
Derbyshire Hards	17/- to 18/-
Rough Slacks	8/6 to 9/6
Nutty Slacks	7/- to 8/6
Blast-furnace Coke (Inland)	10/- on rail at ovens
Furnace and Foundry Coke (Export), f.o.b.,	14/6 to 15/6

(9) SOUTH WALES.

CARDIFF—	
Steam Coals :	
Best Smokeless Large	19/6 to 19/9
Second Smokeless Large	18/9 to 19/6
Best Dry Large	19/- to 19/6
Ordinary Dry Large	17/9 to 18/3
Best Black Vein Large	18/3 to 18/6
Western Valley Large	17/9 to 18/-
Best Eastern Valley Large	17/7½ to 17/9
Ordinary Eastern Valley Large	17/3 to 17/6
Best Steam Smalls	13/- to 13/6
Ordinary Smalls	11/- to 13/-
Washed Nuts	20/- to 32/-
No. 3 Rhondda Large	19/6 to 19/9
" " Smalls	15/- to 16/-
No. 2 " Large	17/- to 17/3
" " Through	15/6 to 16/-
" " Smalls	14/- to 14/3
Foundry Coke (Export)	22/6 to 36/6
Furnace Coke (Export)	15/6 to 16/6
Patent Fuel	22/-
Pitwood (ex ship)	19/- to 20/-
SWANSEA—	
Anthracite Coals :	
Best Big Vein Large	36/- to 38/6
Seconds	27/- to 34/-
Red Vein	22/- to 26/6
Machine-made Cobbles	36/6 to 48/6
Nuts	36/6 to 48/6
Beans	28/6 to 32/6
Peas	19/- to 20/-
Breaker Duff	8/6 to 9/-
Rubbly Culm	8/6 to 9/-
Steam Coals :	
Large	20/- to 20/6
Seconds	18/- to 20/-
Smalls	11/6 to 13/-
Cargo Through	16/- to 17/6

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate: Joists (minimum), 22/6; Ordinary Ship, Bridge, and Tank Plates and Sections, 15/-, if home consumers confine purchases from associated British Steel Makers. (*e*) Delivered Black Country Stations. (*f*) Delivered North-East Coast.

French Engineering Notes.

(From our own Correspondent in Paris.)

The Steel Trade.

MEETINGS of delegates of the steel makers' unions are being held at short intervals to settle the conditions under which the steel cartel shall be renewed for a further period of five years. Notwithstanding the secrecy that surrounds the proceedings, it is understood that each meeting marks some progress. The most serious obstacle to an agreement has, it is reported, been removed by the adhesion of the outside Belgian firm, which has obstinately held aloof in the belief that no sound organisation is possible without the creation of international sales comptoirs under conditions that will eliminate all risk of practices that have wrecked similar comptoirs in the past. This firm is the Forges de Clabecq, which specialises in the rolling of plates, and it is now satisfied with the guarantees that will be provided in connection with the sales comptoirs. Meanwhile, it is understood that the delegates have selected the first half of 1932 as a "period of reference" for export quotas. This gives a little more advantage to Belgium, and after allotments have been made for semi-steels and joists the export quotas will be fixed for sheets and plates. The international sales comptoirs will provide for heavy penalties in the event of members accepting orders outside those allotted to them. The new arrangement will distribute foreign business and will not interfere with the production, each country being free to supply what is necessary for its home market. The cartel will merely exercise a control over the whole organisation.

The "Dunkerque."

Contrary to recent statements, work has not yet been started upon the battleship "Dunkerque," which will be put on the stocks at Brest to be vacated shortly by the cruiser "Algérie." The real reason for the construction of this battleship is that it offers the only means of protecting the lines of communication between France and Algeria against the three German battle-cruisers which completely outclass the French cruisers and can manœuvre out of range of the old battleships. The new German ships entirely upset the French strategical plans in the Mediterranean. Those plans provide for the transport of native troops under reasonable conditions of security, and they explain the refusal of the French to be placed on a naval equality with another Mediterranean Power. The Germans affirm that their aim in building the ships is to ensure an adequate defence in the Baltic, but as her obligations do not leave France indifferent to the Baltic the German ships are regarded as a direct menace to the French there as well as in the Mediterranean. The battleship is thus surviving all attempts at naval disarmament.

The "Atlantique" Inquiry.

The technical inquiry into the loss of the "Atlantique" has come to the unexpected conclusion that the fire was caused maliciously. Monsieur de Bourayne, director of the Inscription Maritime at Bordeaux and president of the Commission of Inquiry, gives reasons for this conclusion that are based upon mere presumption, for there is not the slightest material proof of how the fire originated. The idea of short circuiting being responsible for it is rejected. By a process of deduction it is assumed that the fire started simultaneously in four cabins, separated in pairs by a metallic partition, and that it spread from the floors, wherefore it is concluded that the fire must have been caused by human agency. The Commission seems to have been impressed by information which reached it from abroad, and as criminal action appeared to offer the only reasonable explanation there could be no alternative but to hand the inquiry over to the Judicial Commission. Meanwhile, the owners of the "Atlantique" are embarrassed with the possession of the hull. It would cost a great sum to break it up, and they are anxious to hand it over to the insurance companies. It is suggested that the hull might be reconditioned in a British shipyard, where the work could be done more cheaply than in this country.

The Late Monsieur Mesnager.

By the death in Paris, last week, of Monsieur Augustin Mesnager there has passed away a mathematician and engineer who has exercised a notable influence upon the design of metallic and, particularly, concrete constructions. He was an authority on the resistance of materials and more especially of concrete at a time when little was known about the characteristics of that material. He did much to prepare the way for a better utilisation of concrete. After the collapse of a dam in Algeria some years ago, Monsieur Mesnager declared that there was not a single dam in France that offered a sufficient margin of safety against abnormal pressures, and he further stated that a solid dam capable of providing such a margin would be too costly to build. He advocated arch buttressing as the only means of reducing the volume of material to within reasonable limits. Born in Paris in 1862, Monsieur Mesnager was a Polytechnician and engineer of roads and bridges. In 1900 he was in charge of the laboratory of the Ponts et Chaussées, of which school he afterwards became professor. He was elected member of the Académie des Sciences in 1920. He was also an honorary member of the Institution of Structural Engineers in London.

Boiler Explosion.

The cause of the boiler explosion last week at the Renault motor car factory at Billancourt, near Paris, when nine lives were lost and about a hundred men injured, remains unexplained. The factory is on the banks of the Seine, and it was extended a few years ago across the river to the Ile Séguin, where a power station was installed to supply the whole of the works, the old station being kept in reserve as a standby. As an alternator on the Ile Séguin appeared to be out of balance, steam was raised in the old generators, and about three hours afterwards the boiler-house blew up and caused the collapse of an adjoining toolmaking shop. The maximum working steam pressure was 213 lb. per square inch, but normally it did not exceed 190 lb. The recording indicator showed this pressure at the time of the explosion.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

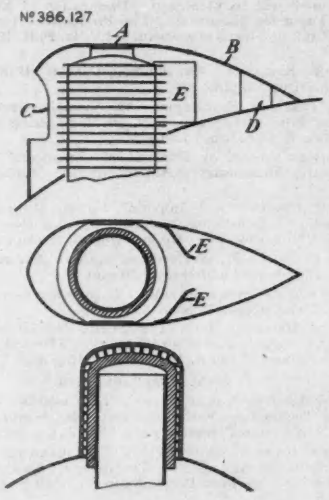
The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

386,127. January 21st, 1932.—AIR COOLING CYLINDERS, Siemens und Halske Aktien-Gesellschaft, Berlin-Siemensstadt, Germany.

According to the present invention, each cylinder is provided with a stream-lined cover which is attached to, or integral with, the cylinder, so as to be in effective thermal connection therewith, the dissipation of heat from the cylinder to the cover being assisted by an intermediately disposed gaseous or liquid medium. The cylinder of the engine is provided with the usual cooling ribs or fins. Integral with these ribs is a band or ring A, to which is attached a stream-lined cover B, shown as formed in

Nº 386,127



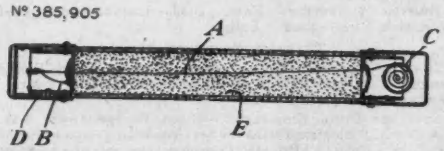
two parts. The forward part of the cover contains an air inlet C, and air outlets D are provided in the rear part. In addition, guide sheets E are fitted inside the cover to cause the incoming cool air to flow past the rear surface of the cylinder. The heat is therefore dissipated partly by the stream of air through the cover and past the cooling fins and cylinder, and it is partly led through the cooling fins to the intermediate band or ring, which is integral therewith, and therefore with the cylinder, and from there it is transmitted partly to the outer current of cooling air and partly to the cover which thus assists in the cooling.—*January 12th*, 1933.

ELECTRICAL APPLIANCES.

385,905. August 24th, 1932.—FUSIBLE CUT-OUTS, *The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, W.C.2.*

The object of the invention is to provide a tension fuse for high-voltage circuits in which a fusible element connected to a spring may be made any size to withstand the spring tension regardless of the current rating of the fuse. When the current flowing through the fuse A is in excess of its rating the pilot

Nº 385,905

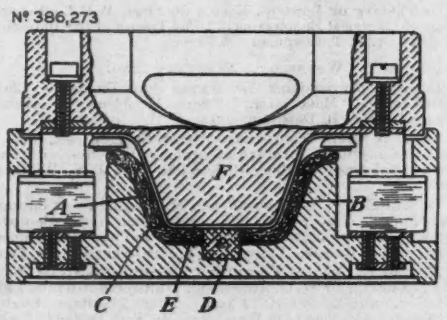


filament B is melted. As the pilot filament melts gases are generated and an arc set up. This causes a rapid melting of the fusible element A, owing to the intense heat at the point where the arc strikes it. When the fusible element A is ruptured the spring-driven drum C is released and rapidly coils the fusible element around it, thus drawing out the arc from the end cup D through the filler E, which serves to cool the arc.—*January 5th*, 1933.

386,273. November 20th, 1931.—ELECTRIC FUSES, John Ashworth Crabtree, of "Endwood," Little Aston Park, Sutton Coldfield.

The fuse dealt with in this specification is of the type in

Nº 386,273



which the fuse wire and its terminals and contacts are carried by a detachable handle that has a depending projection or rib of insulating material that locates the fuse wire within a well or recess of the base member. According to the invention, pieces of sheet asbestos or compressible refractory A B extend for a distance along the bottom of the well C of the fuse. In the middle of the well there is a transverse recess or pocket D, formed to accommodate a moulded piece of plaster of paris or similar arc-quenching material, a part of which projects into the well and occupies the space between the adjacent ends of the two pieces of compressible refractory, thus constituting an arc-quenching bed or seating for the middle portion of the fuse wire E that is passed under the bottom of the handle rib F.—*January 12th*, 1933.

TRANSMISSION OF POWER.

Nº 385,894

385,894. July 26th, 1932.—FRICTION CLUTCHES, P. A. Scott-Iversen, Soudre Fasanvej 67, Copenhagen, Denmark.

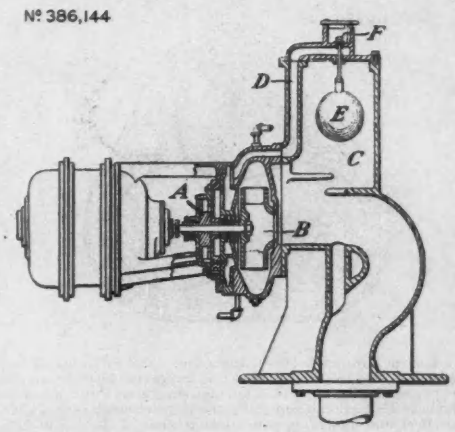
The essence of this invention seems to lie in the substitution of a mass of granular material, such as sand, in the place of individual rollers, in the familiar type of free-wheel device. It is suggested that by making the two interacting parts of the clutch with sloping faces and filling the intervening space with sand, for instance, the two parts will be jammed together on rotation. There is no hint in the specification as to the effect of centrifugal action on the behaviour of the sand.—*January 5th*, 1933.

PUMPING AND BLOWING MACHINERY.

386,144. February 15th, 1932.—PRIMING MECHANISM FOR CENTRIFUGAL PUMPS, *W. W. Triggs, 57, Lincoln's Inn-fields, London, W.C.2.*

This pump is primed by means of a centrifugal air pump A on the same shaft as the main impeller B. The air pump is

Nº 386,144



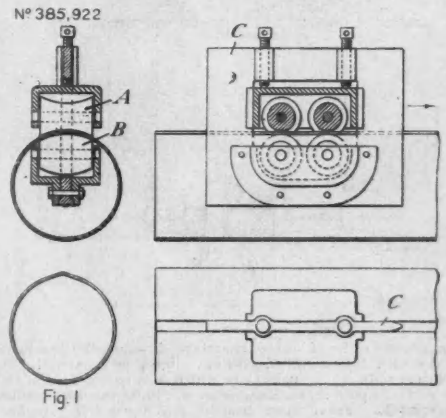
connected with a float chamber C by the passage D. The float E operates a valve F to admit atmospheric air when necessary, and thus maintain a constant level of water in the float chamber.—*January 12th*, 1933.

MACHINE TOOLS AND SHOP APPLIANCES.

385,922. October 1st, 1932.—MAKING TUBES FROM SHEET METAL, Mannesmannröhren-Werke, 1b, Berger Ufer, Düsseldorf, Germany.

In bending sheet metal to make tubes, in the ordinary form of

Nº 385,922



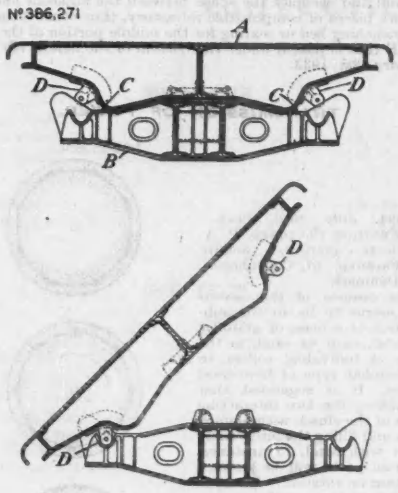
bending rolls it is not possible to bend the sheet right up to the edge and it takes the form shown in Fig. 1, with flat edges. These edges are rounded over by the inventors by means of the device illustrated. The four rollers A B are mounted in frames held together by the plate C. The two edges of the tube are sprung apart to allow the passage of this plate, and recover after the passage of the rolls.—*January 5th*, 1933.

TRAMWAYS AND RAILWAYS.

386,271. August 16th, 1932.—DUMPING WAGONS, *L. Mellersh-Jackson, 28, Southampton-buildings, Chancery-lane, London, W.C.2.*

The essential feature of this invention is that the floor A of

the body of the truck is supported normally by bearing on the underframe B on the wide area from C to C, when it is tipped

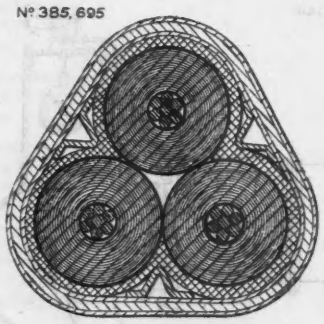


for dumping purposes, it rocks on pivots as shown at D D.—*January 12th*, 1933.

MISCELLANEOUS.

385,695. October 27th, 1931.—ELECTRIC CABLES, C. J. Beaver, Bell-place, Stamford-road, Bowdon, Cheshire; Thomas James Fairfield, "Newlands," Talbot-road, Bowdon, Cheshire; and W. T. Glover and Co., Ltd., Trafford Park, Manchester, Lancashire.

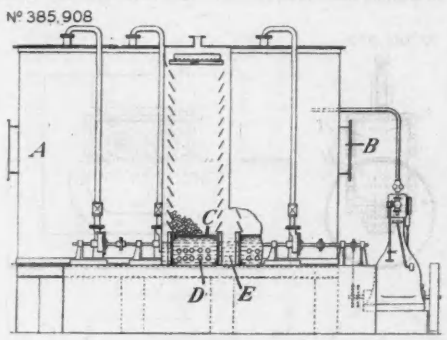
A metal-sheathed electric cable having three or more circular cores, wherein the sheath follows the shape of each core as far as practicable and is in contact with each of the cores for almost the whole of that part of its circumference which is external to



the lines of contact between the cores. The following advantages are said to result from the improved form of sheath as compared with an overall circular sheath on a similar cable. The heat dissipation is superior; the sheath losses are negligible. An effect approximately equivalent to that of the use of individual sheaths for the cores is obtained with a considerable saving of lead and with a reduction in the overall diameter. The expansion and contraction of the sheath may be more effectively provided for.—*January 5th*, 1933.

385,908. August 26th, 1932.—DRYING FUEL GASES, J. W. Napier and Newton, Chambers and Co., Ltd., Thorncliffe Ironworks and Collieries, near Sheffield.

A system for the drying of fuel gas by absorption in a solution of calcium chloride. The object of the invention is to maintain the solution in the most active condition. The wet gas enters the apparatus at A and is delivered dry at B. The apparatus



comprises a series of louvred chambers, down which the solution is cascaded, that are filled with any appropriate material. The solution falls into troughs C, in which it is cooled by the coils D and escapes, in regulated amount, into the intermediate troughs E. From these troughs the liquor is re-circulated through the towers, and at the end of the series a certain portion is drawn off and passed to an evaporator for rejuvenation.—*January 5th*, 1933.

386,143. February 15th, 1932.—PHOTO-ELECTRIC CELLS, *International General Electric Company, Inc., of 120, Broadway, New York, U.S.A.*

A photo-electric cell constructed in accordance with this invention comprises cuprous iodide as the photo-electric substance, which is brought into contact with an electrode which may be of copper, by pressure or fusing. The photo-cell so produced can be employed without an applied voltage. A thin, translucent metallic film produced in the known manner on the layer of cuprous iodide may be used as the other electrode. The advantages of the improved cell reside in the low capacity and the resulting inertia-free operation. The currents have the reverse direction to that of the currents present with a cuprous oxide cell.—*January 12th*, 1933.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Monday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

INST. OF CHEMICAL ENGINEERS.—Hotel Victoria, Northumberland-avenue, W.C.2. Eleventh annual meeting and annual dinner. Annual meeting, 11 a.m. Presidential address, "Chemical Engineering and the Soap Industry," the Rt. Hon. the Viscount Leverhulme, 11.45 a.m. Luncheon, 12.45 p.m. "Metallurgy from the Standpoint of the Chemical Engineer," Mr. L. Singlehurst-Ward, 2.15 p.m. King Edward VII. Rooms, annual dinner, 7 for 7.30 p.m.

INST. OF ELECTRICAL ENGINEERS: LONDON STUDENTS.—Savoy-place, W.C.2. "Order Signalling for Marine and Power Station Equipment," Mr. N. Herwald. 6.15 p.m.

INST. OF MECHANICAL ENGINEERS.—Storey's-gate, St. James's Park, London. Annual general meeting. The Annual Report of the Council will be presented. Declaration of Election of Council. Paper for discussion, "The Production of a Vacuum in an Air Tank by Means of a Steam Jet," Mr. F. R. B. Watson. 5.30 p.m.

INST. OF SANITARY ENGINEERS.—Caxton Hall, S.W.1. Sessional meeting. 6 p.m.

JUNIOR INST. OF ENGINEERS.—39, Victoria-street, S.W.1. "Episodes, Both Grave and Gay, in Engineering History," Eng.-Captain E. C. Smith. 7.30 p.m.

MANCHESTER ASSOC. OF ENGINEERS.—Engineers' Club, 17, Albert-square, Manchester. Annual dinner. 6.45 p.m. for 7.15 p.m.

PHYSICAL SOCIETY.—At Imperial College of Science and Technology, S. Kensington. Editing Committee meeting, 3.30 p.m.; Council meeting, 4 p.m.; general meeting, 5 p.m.

RAILWAY CLUB.—57, Fetter-lane, E.C.4. Annual general meeting. Presidential address. 7.30 p.m.

ROYAL INST. OF GREAT BRITAIN.—21, Albemarle-street, W.1. Discourse, Mr. J. Dover Wilson. 9 p.m.

WEST OF SCOTLAND IRON AND STEEL INSTITUTE.—Royal Technical College, George-street, Glasgow. "Recent Advances in Steel Metallurgy," Dr. A. McCance. 7.15 p.m.

SATURDAY, FEBRUARY 18TH.

INST. OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH.—College of Technology, Sackville-street, Manchester. "Some Practical Non-ferrous Foundry Work," Mr. F. Dunleavy. 4 p.m.

INST. OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH, JUNIOR SECTION.—College of Technology, Sackville-street, Manchester. "Some First Principles in Foundry Practice," Mr. A. Jackson. 7 p.m.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS AND THE COKE OVEN MANAGERS' ASSOCIATION (NORTHERN SECTION).—Lecture Theatre of the Institute, Newcastle-upon-Tyne. "Preparation of Coal," Mr. E. M. Myers. 2.30 p.m.

ROYAL INST. OF GREAT BRITAIN.—21, Albemarle-street, W.1. "Detection and Production of Swift Particles," Lord Rutherford, F.R.S. 3 p.m.

MONDAY, FEBRUARY 20TH.

BRADFORD ENGINEERING SOC.—Joint meeting with the Technical College, Technical College, Bradford. "Lubrication of Internal Combustion Engines," Mr. A. E. Lawson. 7.30 p.m.

ENGINEERS' GERMAN CIRCLE.—At Inst. of Mechanical Engineers, Storey's-gate, S.W.1. "New Developments in the Design of Rolling Mill Equipment," Herr Dip.-Ingenieur Ernst Kugel. 6 p.m.

INST. OF AUTOMOBILE ENGINEERS.—At 39, Elmbank-crescent, Glasgow. "An Experimental Investigation of Flow in Oil-engine Injection Systems," Dr. S. J. Davies. 7.30 p.m.

WOLVERHAMPTON AND DISTRICT ENGINEERING SOC.—Victoria Hotel, Wolverhampton. "Modern Developments in Bridge Building," Mr. F. H. Abrahams. 7.30 p.m.

MONDAY, FEBRUARY 20TH, TO FRIDAY, MARCH 3RD.

BRITISH INDUSTRIES FAIR, 1933.—London and Castle Bromwich, Birmingham. Daily.

TUESDAY, FEBRUARY 21ST.

INST. OF AUTOMOBILE ENGINEERS.—Victoria Hotel, Wolverhampton. "Some Problems in Chassis Design," Mr. L. Dawtrey. 7.30 p.m.

INST OF CIVIL ENGINEERS.—Great George-street, S.W.1. Discussion, "Electric Trains for Services with Frequent Stops," Mr. C. B. Unwin; "Primary Considerations relating to Steam, Electric, and Diesel Engine Traction," Mr. H. W. H. Richards; "Some Features of Design in Electric Rolling Stock for Intense Service," Mr. W. S. Graff-Baker. 6 p.m.

INST. OF ELECTRICAL ENGINEERS: NORTH MIDLAND CENTRE.—"Electric Lighting of Buildings," Mr. A. B. Read and Dr. J. W. T. Walsh. 7 p.m.

OLD CENTRALIANS.—Devereux Restaurant, Devereux-court, W.C.2. Luncheon. 1 p.m.

ROYAL INST. OF GREAT BRITAIN.—21, Albemarle-street, W.1. "Analysis of Crystal Structure by X-rays: A Review of the Work of Twenty Years," Sir Wm. Bragg, F.R.S. 5.15 p.m.

SHEFFIELD METALLURGICAL ASSOC.—198, West-street, Sheffield. "Spring and Spring Steels," Mr. H. W. Webster. 7.30 p.m.

UNIVERSITY OF LONDON, KING'S COLLEGE, W.C.2.—Department of Electrical Engineering. "The Theory of the Induction Motor," Dr. F. T. Chapman. 5.30 p.m.

WEDNESDAY, FEBRUARY 22ND.

INST. OF AUTOMOBILE ENGINEERS.—At Engineers' Club, Albert-square, Manchester. "Some Problems in Chassis Design," Mr. L. H. Dawtrey. 7 p.m.

INST. OF CIVIL ENGINEERS.—Great George-street, S.W.1. Students' meeting. "Design of Sewerage Schemes, with Particular Reference to Rainfall Run-off," Mr. J. S. Williams. 6.30 p.m.

INST. OF ELECTRICAL ENGINEERS: N.-EASTERN.—At Literary and Philosophical Society, Westgate-road, Newcastle-upon-Tyne. Faraday Lecture, "Lightning—and how the Engineer Deals with its Effects," Professor J. T. MacGregor-Morris. 7 p.m

INST. OF ELECTRICAL ENGINEERS: S. MIDLAND STUDENTS.—Visit to works, Sir W. G. Armstrong, Whitworth Aircraft, Ltd., Whitley, near Coventry. 3 p.m. Benn Buildings, Rugby. "Electrical Equipment of Warships," Mr. F. C. Duffield. 7 p.m.

ROYAL AERONAUTICAL SOC.—At Royal Aero Club, 119, Piccadilly, W.1. Film, "The National Air Races of America (1932)." Mr. R. L. Preston will describe the film. 6.30 p.m.

ROYAL SOC. OF ARTS.—John-street, Adelphi, W.C.2. "Industrial Research with Biological Material," Sir William B. Hardy, F.R.S. 8.30 p.m.

THURSDAY, FEBRUARY 23RD.

GLASGOW UNIVERSITY ENGINEERING SOC.—James Watt Laboratories, University, Glasgow, W.2. "Recent Developments of Aircraft Engines, with Some Reference to Schneider Trophy Aircraft Engines," Major G. P. Bulman. 7.30 p.m.

INST. OF ELECTRICAL ENGINEERS.—Savoy-place, W.C.2. "Characteristics of Submarine Telephone Cables at Carrier Frequencies," Dr. E. W. Smith. 6 p.m.

INST. OF STRUCTURAL ENGINEERS AND SOCIETE DES INGENIEURS CIVILS DE FRANCE.—At Inst. of Mechanical Engineers, Storey's-gate, S.W.1. "Solar Illumination of the Interior of Large Buildings," M. Jacques Arthuys. 5.30 p.m.

FRIDAY, FEBRUARY 24TH.

INST. OF MUNICIPAL AND COUNTY ENGINEERS.—Metropolitan District meeting at Wandsworth, Clapham Baths, Manor-street, High-street, Clapham. 6.30 p.m.

INST. OF PROFESSIONAL CIVIL SERVANTS.—At Royal Soc. of Arts, John-street, Adelphi, W.C.2. "Air Photography and Archæology," Mr. O. G. S. Crawford. 5.30 p.m.

JUNIOR INST. OF ENGINEERS.—39, Victoria-street, S.W.1. "Smoke Detection and Measurement," Major C. E. Prince. 7.30 p.m.

NORTH-EAST COAST INST. OF ENGINEERS AND SHIPBUILDERS.—Mining Institute, Newcastle-upon-Tyne. "The Water-tube Boiler and the Cargo Ship," Engineer Rear-Admiral W. M. Whayman and Major W. Gregson. 6 p.m.

ROYAL INST. OF GREAT BRITAIN.—21, Albemarle-street, W.1. Discourse, "Photographic Analysis of Explosion Flames," Professor W. A. Bone. 9 p.m.

SATURDAY, FEBRUARY 25TH.

INST. OF ELECTRICAL ENGINEERS: S. MIDLAND STUDENTS.—Visit to British Industries Fair, Castle Bromwich.

INST. OF MUNICIPAL AND COUNTY ENGINEERS: S. EASTERN DISTRICT MEETING.—Assemble Council Offices, Purley. 11 a.m.

ROYAL INST. OF GREAT BRITAIN.—21, Albemarle-street, W.1.—"Detection and Production of Swift Particles," Lord Rutherford. 3 p.m.

MONDAY, FEBRUARY 27TH.

INST. OF MECHANICAL ENGINEERS: GRADUATES' SECTION.—Storey's-gate, S.W.1. "Plain Bearings," Mr. J. Robinson. 6.45 p.m.

TUESDAY, FEBRUARY 28TH.

INST. OF ELECTRICAL ENGINEERS.—North British Station Hotel, Edinburgh. "Present Practical Limits of Power Station Efficiency," Mr. W. S. Burge. 7 p.m.

INST. OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND.—39, Elmbank-crescent, Glasgow, C.2. "Electric Arc Welding in Ship Construction," Mr. J. L. Adam. 7.30 p.m.

INST. OF FUEL.—Technical College, Green-lane, Derby. "Survey of Modern Tendencies in Boiler Design," Mr. F. Dransfield. 7 p.m.

SHEFFIELD METALLURGICAL ASSOC.—198, West-street, Sheffield. "Some Unusual Methods of Analysis," Mr. T. R. Walker. 7.30 p.m.

WEDNESDAY, MARCH 1ST.

SOC. OF GLASS TECHNOLOGY: LONDON SECTION.—Visit to works of United Glass Bottle Manufacturers, Ltd., Charlton, S.E.7. 7.30 p.m.

THURSDAY, MARCH 2ND.

INST. OF CIVIL ENGINEERS.—Great George-street, S.W.1.—Lecture, "The Zuider Zee Works," Mr. V. J. P. De Blocq van Kuffeler. 6 p.m.

INST. OF METALS.—University, Edmund-street, Birmingham. "Spectrographic Analysis," Mr. E. H. S. van Someren. 7 p.m.

FRIDAY, MARCH 3RD.

INST. OF LOCOMOTIVE ENGINEERS.—Trocadero Restaurant, Shaftesbury-avenue, W.1. Annual dinner. 6.30 for 7 p.m.

INST. OF MECHANICAL ENGINEERS.—Storey's-gate, S.W.1. Informal meeting. Discussion, "Modern Steam Propulsion for Ships," to be introduced by Major William Gregson. 7 p.m.

JUNIOR INST. OF ENGINEERS.—39, Victoria-street, S.W.1. "Virtues and Vices of Some Metals," Mr. W. E. W. Millington. 7.30 p.m.

SUNDAY, MARCH 5TH, TO SUNDAY, MARCH 12TH.

LEIPZIG SPRING FAIR.—Daily.

MONDAY, MARCH 6TH.

ROYAL SOC. OF ARTS.—John-street, Adelphi, W.C.2. Cantor Lecture. "Welding and Allied Processes for Engineering Purposes," Mr. Arthur Stephenson. 8 p.m.

WEDNESDAY, MARCH 8TH.

INST. OF FUEL.—At Chemical Society's Rooms, Burlington House, W.1. "Three Coal Cleaning Processes New to British Practice." 6 p.m.

INST. OF FUEL.—At Engineers' Club, Albert-square, Manchester. "Use of Refractories in the Fuel Industries," Mr. Colin Presswood. 7 p.m.

INST. OF METALS.—Trocadero Restaurant, Piccadilly Circus, W.1. Annual dinner and dance. 7 p.m.

WEDNESDAY AND THURSDAY, MARCH 8TH AND 9TH.

INST. OF METALS.—At Inst. of Mechanical Engineers, Storey's-gate, S.W.1. Twenty-fifth annual general meeting. 10 a.m. each day. For papers to be read see page 178.

FRIDAY, MARCH 10TH.

INST. OF FUEL.—At Engineers' Club, Albert-square, Manchester. "Design and Operation of Gas, Oil and Electrical Furnaces," Mr. S. N. Brayshaw. 7 p.m.

JUNIOR INST. OF ENGINEERS.—39, Victoria-street, S.W.1. "Notes on Engineering Achievements in S. Africa," Mr. F. C. Meadows. 7.30 p.m.

NORTH-EAST COAST INST. OF ENGINEERS AND SHIPBUILDERS.—Bolbec Hall, Newcastle-upon-Tyne. "Structural Discontinuities," Dr. B. C. Laws. 6 p.m.

MONDAY, MARCH 13TH.

INST. OF METALS.—At Inst. of Engineers and Shipbuilders in Scotland, 39, Elmbank-crescent, Glasgow. Annual general meeting. Paper, "Welding," Messrs. M. Brownlie and J. Arnott. 7.30 p.m.

ROYAL SOC. OF ARTS.—John-street, Adelphi, W.C.2. Cantor Lecture. "Welding and Allied Processes for Engineering Purposes," Mr. Arthur Stephenson. 8 p.m.

TUESDAY, MARCH 14TH.

INST. OF METALS.—Y.M.C.A., Swansea. "Some Recent Advances in Rolling Mill Practice Abroad," Mr. G. A. V. Russell. 6.15 p.m.

INST. OF METALS.—At Armstrong College, Newcastle-upon-Tyne. Annual general meeting. Discussion, "Testing of Non-ferrous Metals." 7.30 p.m.

THURSDAY, MARCH 16TH.

INST. OF METALS.—University, Edmund-street, Birmingham. "Metals in the Electrical Industries," Dr. C. J. Smithells. 7 p.m.